SEPARATE AC

WITH APPENDIX ON

JOHN STRUT

ON

SEPARATE ACROMION PROCESS,

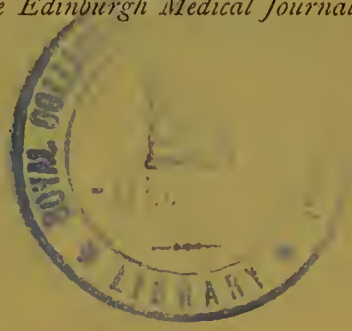
WITH APPENDIX ON SUB-CORACOID DISLOCATION OF THE HUMERUS.

BY

JOHN STRUTHERS, M.D., LL.D.,

PRESIDENT OF THE ROYAL COLLEGE OF SURGEONS OF EDINBURGH;
FORMERLY LECTURER ON ANATOMY, AND SURGEON TO THE ROYAL INFIRMARY, EDINBURGH;
EMERITUS PROFESSOR OF ANATOMY, ABERDEEN UNIVERSITY.

(*Reprinted from the Edinburgh Medical Journal*, 1895–96.)



EDINBURGH:
OLIVER AND BOYD, TWEEDDALE COURT.

MDCCCXCVI.

CONTENTS.

ON SEPARATE ACROMION PROCESS SIMULATING FRACTURE.

HAVING met with this condition frequently in the dissecting-room I was led to examine the exact anatomy of the part and to consider the causes that might bring about and maintain the condition. Most surgical museums probably contain one or more specimens of this condition, marked as cases of "ununited fracture." When we look at the exposed position of the acromion, and its thinness in front of the beam that rises to it from the spine, we would expect fracture of the acromion to be a more frequent occurrence than the statements in surgical text-books imply. Evidence that true fracture of the acromion, occurring at various places and in various directions, is not infrequent, but is overlooked from the absence of displacement, will fall to be noticed below in order to draw the distinction between the appearances in that occurrence and those in the condition I have to describe.

The condition in question may, possibly, still come within the category of fracture in the sense that it may, in some cases, have begun as a fracture of the layer of cartilage between the basi-acromion and the ossified epiphysis; and, in that event, the movements of the acromion against the clavicle might be sufficient to prevent union and to establish a joint between the two parts of the acromion. That, however, is not likely to have been the history in cases (as in Case No. 3, figs. 6 and 6*a*) in which the separation exists on both sides.

The relation of the clavicle to the acromion is a fundamental consideration in the inquiry, whether as regards true fracture or the condition in question. The normal anatomy, as bearing on that relation, has first to be considered; then the development of the acromion; and thereafter we are in a position to appeciate the distinction between the condition seen in the specimens which I have to describe and the condition of true fracture of the acromion.

The condition of separate acromion process, in whatever way arising, is not without practical interest. Although, in a case of supposed fracture, the time for crepitus may be past, the condition may be recognisable in the living body by the amount of motion; and, if noticed some time after a contusion of the shoulder, a question might arise whether the contusion had been the cause of the alleged fracture. Again, the not infrequent association of the condition of separate epi-acromion with the condition of the shoulder joint, usually called "rheumatoid arthritis," referred to below in connexion with Case No. 1, is of interest in its bearing on the question of the usual causation of the latter as well as of the former of these conditions.

I. Preliminary Anatomical Considerations.

Relation of clavicle to acromion. Ligaments and movements. Interior of acromio-clavicular joint. Adaptations. Inter-articular fibro-cartilage. Various forms of Acromion Process.

(*a.*) The *relation of the clavicle to the acromion* is an important consideration in looking for a natural cause of continued separation of the epiphysis of the acromion. The natural relation of the parts is seen in fig. 1. In the abutting of the acromion against the end of the clavicle during the movements of the scapula there is considerable transverse force. Shock is lessened by various adaptations; the very oblique direction, outwards and backwards, of the clavicle; and the form of the joint, which allows of movement in any direction.

(*b.*) *Ligaments and movements.*—The joint is in itself a weak one, serving merely as a pivot on which the scapula moves. Its great securing ligament is the distant trapezoid part of the coraco-clavicular ligament. The superior acromio-clavicular ligament is a fairly thick strap, about an inch in breadth and in length, and is continued round the front and back, and from the front a little way in below. The so-called inferior acromio-clavicular ligament beyond that is a very weak structure, at the middle only a thin strengthening of the synovial capsule, scarcely worthy of being called a ligament. It is a part very seldom examined in the dissecting-room.

These parts of the ligament afford some check to over-movement; the anterior and posterior parts to forward and backward gliding of the acromion; the superior part to vertical gliding; and the several parts come variously into play in checking rotatory movements of the scapula on the clavicle, that is, movements in which the lower angle of the scapula moves forwards or backwards. The superior ligament is generally regarded as a provision to prevent the clavicle slipping over the acromion (more correctly expressed, the acromion slipping under the clavicle, as the scapula is the moving bone), but it is not evident how a ligament placed

above will check such a movement more than one placed below would. The function of a ligament is seen by looking at the direction of its bundles. Those of this ligament are directed outwards and forwards, as seen in fig. 1, continuing the direction of the outer end of the clavicle, and the adaptation of the ligament seems to be to resist outward traction, as by the weight of the scapula and limb, or by the traction of the deltoid muscle when its humeral attachment is the more fixed point. As above remarked, the coraco-clavicular ligament is really the great ligament of the acromio-clavicular joint, and the scapula is further naturally held up by the trapezius muscle.

(*c.*) *Interior of the acromio-clavicular joint.*—The appearances may be here noted as the condition of this joint has to be observed in cases of separate epi-acromion. Very frequently, and apparently independent of disease or age, the articular cartilage *on the clavicle* is not smooth and polished like ordinary articular cartilage, but in a spongy condition, $\frac{1}{12}$ to $\frac{1}{10}$ inch thick, giving it the character of a cushion. The *facet*, as seen on macerated bones, is often irregular and foraminated on the surface, and indistinctly bordered. Normally the facet occupies the whole of the true outer end of the bone in length and depth. The end may be sharply square-cut, but behind the articular surface proper the border of the bone rounds off backwards and inwards, broadening the bone, so that the seeming posterior angle may be $\frac{1}{2}$ inch or more from the true end. This rounded part is the rough ligamentous area for the attachment of the back part of the superior ligament. In cases of separate epi-acromion the posterior bundles of this part of the ligament attach the clavicle to the basi-acromion, and the deeper bundles separate the acromio-clavicular synovial cavity from that of the intra-acromial joint.

The *facet on the acromion* is generally better defined, the cartilage smooth; and, on the macerated bones, the articular lamina less foraminated. Whether it reaches to the front of this border of the acromion depends on the form of the latter, as seen in the different figures given. Care is required in defining the posterior end of the facet, a point of interest in deciding whether, in cases of separate epi-acromion, the clavicle has rested in part on the basi-acromion. Behind the facet proper there is a small triangular area, $\frac{1}{4}$ to $\frac{1}{2}$ inch in length, the apex meeting the anterior apex of the bevelled impression on the spine of the scapula for the attachment of the trapezius muscle. The upper part of this area attaches the deeper part of the superior acromio-clavicular ligament, the remainder may be foraminated or smooth. The fore part of this area is apt to be taken for the back part of the facet, but the limit of the facet proper is marked by a finished line. In some of the cases of separate epi-acromion noted below (Nos. 6 and 10, and shown in fig. 7), we have to see that the facet does reach for a small way on the basi-acromion.

Normally the facet has an average length of $\frac{3}{4}$ inch; depth about half the length; form elliptical, lower edge generally the least bent; surface nearly plane, but usually a little concave both ways. The end of the clavicle has its curves the reverse, but it is often irregular.

(*d.*) *Adaptations of the joint.*—In direction, antero-posteriorly, the acromio-clavicular joint is nearly at right angles to the axis of the outer part of the clavicle, the direction of which is outwards and a little forwards, and the line of the joint is directly intersected by the line of the bundles of the superior ligament. The clavicle thus, in the antero-posterior direction, abuts directly against the acromion. Vertically, the oblique cutting, downwards and inwards, is, in some of the cases of separate epi-acromion noted below, very little, but is usually marked.

This oblique cutting is supposed to be an adaptation to prevent the displacement upwards of the scapula during force from below. The adaptation would be more correctly expressed by saying that, as the plane of the acromion is oblique downwards and outwards, the slant at the joint brings the acromion more directly against the clavicle, thereby giving it a better pivot of support to move on, than if the intersection had been vertical. The obliquity of the intersection is, however, generally greater than is required to make it rectangular to the acromial plane, and will, so far, correct the tendency there would have been for the acromion to be displaced upwards if the intersection had been vertical. Antero-posterior gliding at the joint will tend to obviate shock more than the vertical gliding will. Both are soon checked by the ligaments, mainly by the coraco-clavicular.

(*e.*) The *inter-articular fibro-cartilage*, partial or complete, that used to be described at the acromio-clavicular articulation as a further provision for obviating shock, I find to be rarely present. Though I have often looked for it, I have only once in my dissecting-room experience met with a fibro-cartilage here with complete synovial cavity on each side. That was in Case No. 4, noted below. Nor does a partial wedge-shaped fibro-cartilage occur often, such as that noted below in Case No. 3, best marked on the right side. There are often, indeed generally, synovial fringes projecting into the joint, especially hanging into it from the superior ligament, which probably have been taken for a partial fibro-cartilage. But when the latter occurs its cartilaginous nature is evident.

(*f.*) *Various forms of the Acromion Process.*—The general form of the acromion in cases of separate epi-acromion appears frequently to be unusual. Irrespective of that condition, the acromion varies much in form, but, for description, four types may be defined, between which there are intermediate forms. Figs. 10 to 13 show these four types diagrammatically, arranged in the order of frequency. The equal frames, with equal subdivisions, enclosing or intersecting the figures, will assist the eye in recognising the

parts that are wanting or excessive. The facet for the clavicle is indicated on the inner side of each.

(1.) *Quadrate form* (as in fig. 10); posterior angle prominent, may approach to nearly a right angle, but generally somewhat rounded. Anterior end square-cut, presenting antero-external and antero-internal angle; in some so sharp-cut here as to make two nearly right angles; not projecting beyond clavicle, but continuing the line of curvature of anterior border of clavicle onwards to the antero-external angle, the most projecting part of the acromion anteriorly. Outer border moderately convex, undulating if the tubercles are well marked. Inner border, behind facet, short, and forms either obtuse angle or concavity with upper border of crest of spine.

(2.) *Ovoid form* (as in fig. 11); posterior angle may be more rounded, but chief character is the blunt-pointed projection of anterior end beyond clavicle. The facet thus does not reach to fore part of inner border.

(3.) *Triangular form* (as in fig. 12); antero-external angle deficient.

(4.) *Crescentic form* (as in fig. 13); posterior angle and antero-external angle both deficient. In the latter two types the outer border of the acromion is much bent.

The outer edge of the acromion generally shows a series of tubercles with intervening smooth depressions, seen on the upper aspect, corresponding to the attachment of the intra-muscular tendinous septa of the deltoid muscle. The tubercles, besides the projection of the point and that of the posterior angle, are usually three in number. The tubercles are more easily reckoned than the spaces. It is noted below with each case how many of these tubercles are carried by the separate epi-acromion.

II. Development of the Acromion.

Fully the larger part of the adult acromion is formed by ossification from the spine. That is seen in the figures 2, 3, 4, and 5. In all my specimens that ossification forms the posterior angle of the acromion. Towards it the cartilaginous acromion, already with its definite shape in the young subject, sends a narrow tail-like process backwards, but not reaching quite to the angle. The line of junction of the ossifying basi-acromion with the cartilaginous epi-acromion is convex, generally most prominent to the inside of the middle, and slopes very obliquely outwards and backwards to near the posterior angle. The ossifying basi-acromion shows a series of projections or tubercles, like the knuckles of the closed hand, generally seven in number, sometimes pretty uniformly arranged (as in figs. 2 and 5), sometimes with irregularities in size (as in figs. 3 and 4). The irregularity seen in fig. 4 is in adaptation to the osseous centres of the epi-acromion; that seen in fig. 3 is before ossific centres have appeared in the epi-acromion.

Notes of five specimens showing stages of ossification of the Epi-acromion.

The following notes, and the figures referred to, show the stages of ossification of the acromion process, as seen in the series of specimens of young scapulæ in my collection. As I am unable to give the ages, the dimensions of the scapulæ and the condition of each in regard to the ossification of its other parts are given, but the progressive steps of the ossification are seen.[1] The notes of each should be read in connexion with the figures (figs. 2, 3, 4, and 5). The following Table (Table I.) will facilitate comparison between the five young specimens noted.

Table I.—*For comparison among the five specimens of young scapulæ noted below, relating to ossification of the epi-acromion; the measurements of the scapulæ given in inches, those of the epi-acromion in $\frac{1}{12}$ths of an inch.*

Number of Specimen.	Figure.	Scapula.		Entire Acromion.		Length of part formed by Epi-acromion.	Condition of Epi-acromion.
		Length.	Breadth.	Length.	Breadth.		
1	2	$3\frac{1}{4}$	2	$\frac{11}{12}$	$\frac{7}{12}$	$\frac{5}{12}$	Cartilaginous.
2	3	$4\frac{1}{4}$	$2\frac{3}{4}$	$1\frac{1}{12}$	$\frac{8}{12}$	$\frac{5}{12}$	Ossific centre at point.
3	4	$5\frac{7}{8}$	$3\frac{3}{8}$	$1\frac{8}{12}$	$\frac{8}{12}$	$\frac{8}{12}$	Seven ossific centres.
4	...	$4\frac{6}{8}$	$3\frac{2}{8}$	$1\frac{8}{12}$	$\frac{10}{12}$	$\frac{8}{12}$	Ossification advanced.
5	5	$5\frac{3}{8}$	$3\frac{6}{8}$	$1\frac{10}{12}$	$\frac{10}{12}$	$\frac{10}{12}$	Epiphysis completely ossified.

[1] *Usual order and periods of ossification.* The following are the ages assigned for the appearance of ossific centres, and for the consolidation of the several parts of the scapula, in the latest edition of *Quain's Elements of Anatomy*, now appearing, 10th ed., vol. ii., part 1, 1890. Centre for the body, 7th or 8th week intra-uterine, spine showing about 3rd month; centre for coracoid in first year after birth; for the sub-coracoid ossicle, at top of glenoid cavity, about 10th year; coracoid joins body about age of puberty; centre in cartilage of base, about 16th to 18th year, beginning at lower angle and thereafter extending upwards along base. "A thin lamina, in two pieces, is also added along the upper surface of the coracoid process, and another at the margin of the glenoid cavity. These epiphyses are united about the 25th year." Of the *acromion* the account is:—"In the acromion two, sometimes three, nuclei appear between the 14th and 16th years; they soon coalesce, and the resulting epiphysis is united to the spine from the 22nd to the 25th year." Of three figures given, one, at 15 or 16 years, shows one nucleus at about the centre of the cartilage; one, at 17 or 18 years, shows two nuclei, one in front of the other along the middle; the third shows the completed epiphysis. In the latter, the line of meeting with the basi-acromion corresponds generally to what is seen in my specimens, but the prolongation of the epiphysis backwards is too broad and goes back so as to include the posterior angle. The condition shown in the first two figures is quite unlike what is seen in my specimens and shown in my figures.

Specimen 1. Young scapula in which the epi-acromion is still entirely cartilaginous. Fig. 2.

Length of ossified scapula 3¼ inches, breadth 2. *Acromion*, general form quadrate, posterior angle somewhat rounded; length 1½ inch, of which ossified basi-acromion forms $\frac{6}{10}$. *Basi-acromion*, breadth rather greater than length; the ossification continued from spine shows seven rounded tubercles projecting like knuckles of closed hand, in a line falling away a little to inside but mainly curving downwards and outwards, the last one broad and forming the posterior angle of the acromion. *Epi-acromion*, as yet without ossific centre; sends a narrow tail-like strip backwards to near, but not quite to, the ossified posterior angle of the acromion.

Specimen 2. Scapula larger than the preceding; one ossific centre in epi-acromion. Fig. 3.

Scapula, length 4¼ inches, breadth 2¾. *Acromion*, quadrate; length 1 $\frac{1}{10}$, of which ossified part forms $\frac{7}{10}$, breadth of latter $\frac{8}{10}$. Line of the tubercles of basi-acromion irregular (as seen in fig. 3), not turning backwards till on outer third. *Epi-acromion*, only one small ossific centre, occurring at anterior end towards antero-internal angle. The caudate strip of cartilage goes back to near the posterior angle, meeting the last tubercle of basi-acromion in front of the ossified posterior angle.

Specimen 3. Larger scapula than the preceding; several centres of ossification in epi-acromion. Fig. 4.

Scapula, length 5⅜ inches, breadth 3⅝, small cartilage at lower angle not yet ossifying; vertebral border below spine concave; coraco-scapular suture beginning to disappear but mostly visible; scale-like epiphysis on coracoid ossified. This epiphysis corresponds to attachment of coraco-clavicular ligament; coraco-scapular suture crosses under its back part. *Acromion*, form triangular with convex outer border; length 1 $\frac{8}{10}$, of which ossified part forms 1 inch; breadth $\frac{9}{10}$. *Epi-acromion*, ossific centres numerous, seven in all (see fig. 4); (*a*) one at the point, small; (*b*) two on the inner side, one of them small, the other long and resting on the two inner tubercles of basi-acromion; (*c*) three on outer side, two of them small, one of them long, the largest of the whole, resting in hollow between two tubercles of basi-acromion. The greater part of the breadth of the epi-acromion, that between the outer and inner series of ossific centres, is not ossified. (*d*) A centre placed in the position of the caudal process, in front of posterior angle of acromion. This accessory epiphysial centre ($\frac{6}{10}$ inch in length, $\frac{1}{10}$ in breadth), is seen very distinctly on the under surface and as forming the edge of the acromion here, but is narrowly seen on the upper aspect, not so broadly as put in the figure (fig. 4) in order to show its position longitudinally. It is at a distance of $\frac{2}{10}$ inch from the long external centre in front of it. The strip of cartilage that no doubt contained this ossific centre has not been preserved in the specimen. In specimen No. 5 we have to see this accessory centre joined to the one in front of it by a narrow neck.

On the outer margin of the acromion, three moderate prominences are seen; one behind, at the accessory centre; two in front of that, one related apparently to the position of the greater ossification, the other to the position of the two lesser ossifications.

Specimen 4. Smaller scapula than the preceding (No. 3), but in which ossification of the epi-acromion is much more advanced (not figured).

Scapula, length 4⅝ inches, breadth 3⅜ ; small cartilage at lower angle, as in preceding case, not ossifying. Vertebral border below spine, convex. Coraco-scapular suture obliterated except on subscapular aspect ; scale-like epiphysis on coracoid well ossified. *Acromion*, of the marked triangular type, length 1 9/12, of which ossified acromion forms 1 inch ; breadth 10/12. *Epi-acromion*, anterior and middle part entirely ossified, but posterior caudate part lost, exposing the two outer tubercles of the basi-acromion and part of the next tubercle. While the ossification of the epi-acromion is continuous, thicker parts are seen ; one on the outer border, one at the point, and one along the inner border, the latter bearing the whole of the clavicular facet. These thicker parts correspond to the position of the centres of ossification noted in the preceding case (No. 3), and are separated by depressed parts with a finely pitted surface, the thicker parts smooth, the inner thickening least so. These thickenings are less marked on the under surface, nearly the whole of which is finely pitted. The ossified epi-acromion has a yellow colour, which, with the mottling on the surfaces, reminds one of the appearance presented by calcified sternal ribs, contrasting with the even surface of the basi-acromion.

In regard to the probable age of this scapula, it corresponds pretty nearly in size to one known to be at the 17th year, female, from which the epi-acromion is lost. Coraco-scapular suture seen all round.

Specimen 5. Scapula with epi-acromion completely ossified but not united to the basi-acromion ; showing distinctly the relation of ossification to the formation of permanently separate epi-acromion. Fig. 5.

Scapula, length 5⅜ inches, breadth 3⅝ ; small epiphysis ossifying on base close to lower angle ; base below spine, convex ; coraco-scapular suture has entirely disappeared ; scale-like epiphysis on angle of coracoid well seen and still separate. *Acromion*, of mixed type, broadly crescentic behind and at middle, but antero-external angle prolonged ; length of entire acromion 1 9/12 inches, of which epi-acromion occupies the 10/12 ; breadth at middle 10/12.

The appearances presented by the now ossified *epi-acromion* deserve particular mention. As noted with the preceding specimen (No. 4), there are thicker parts along the sides and at the point. The external thickening is the most marked ; extends along the anterior ¾ of the acromion to the point. The part at the point (4/12 inch in length and broadened) is marked off from the latter by a depression, and from the internal thickening by a recess at the middle of the very obliquely-cut anterior end of the acromion, as shown in the figure (fig. 4). The thickening on the inner side is less marked, but is distinct and carries the whole of the clavicular facet. The external thickening is all along marked by an inner sharp serrated edge, which at the middle of the acromion curves inwards as far as to reach the middle tubercle of the basi-acromion. On the under aspect, the distinction of the thickenings is less marked ; the surface coarsely pitted, except on the back part of the outer thickening.

The posterior *caudate* part of the epi-acromion is well seen here. Joining the narrow posterior end of the main part of the epi-acromion by a narrow neck (2/12 inch in length, 1/12 in breadth), it broadens backwards as an ovoid scale (4/12 in length, 2/12 in breadth) as shown in the figure (fig. 5). It is seen on the upper aspect and on the outer border of the acromion, and forms half the thickness of the outer border, but is barely seen on the under aspect. The posterior end of this caudate process does not go so far as the posterior end of the outer border of the acromion, the angle being, as usual, ossified from the spine. Along the outer border of the acromion, three moderate elevations are seen besides that formed by the point, and the one formed by the caudate process behind its narrow neck, at which a concavity is seen on the border.

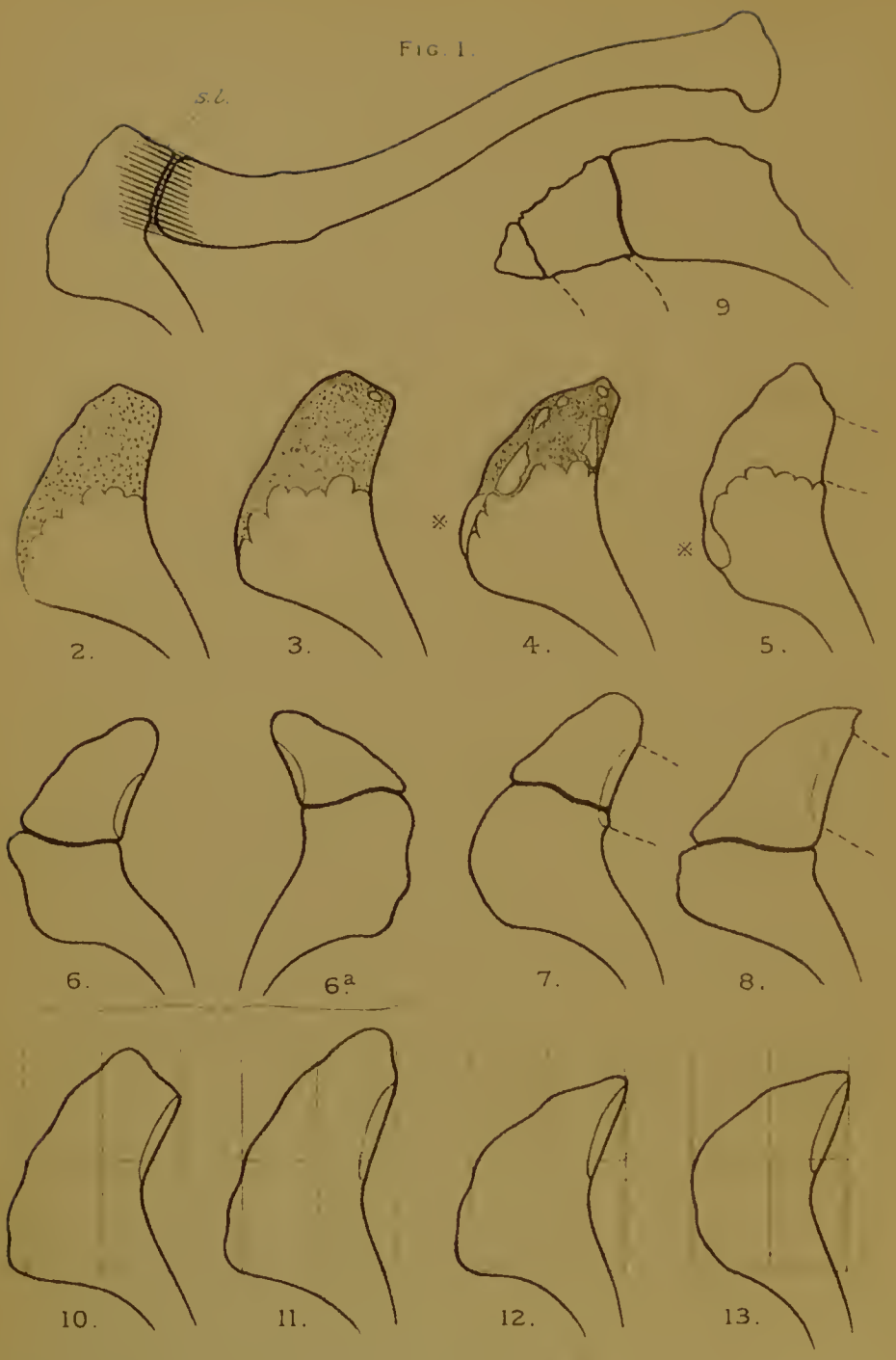


Fig. 1, Normal anatomy. Reduced ½.
Figs 2 to 5, stages of development.
Figs 6 to 9, cases of separate epi acromion in adult or old.
Figs 2 to 9, variously reduced to same size, for comparison.
Figs 10 to 13, diagrams of typical forms.

John Struthers del

SEPARATE ACROMION PROCESS, SIMULATING FRACTURE.

These particulars in regard to the ossification of the acromion appear worthy of notice in relation to the adaptations of the acromion, and to the occasional occurrence of permanently ununited epi-acromion. We see the earlier ossification of the epi-acromion at its outer and inner sides than at the middle; at the outer, in relation to the attachment of the deltoid muscle; at the inner, in relation to the support of the clavicle. The accessory centre noted with specimen No. 3, is seen in specimen No. 5 to unite by a narrow neck with the main part of the epiphysis, forming a kind of splint between the two. Should this union fail to take place, we have a precise explanation, if not of the cause of permanently ununited epi-acromion, at least of the form which it presents.

Explanation of the Plate.

Fig. 1.—Normal, from a preparation, reduced ½. Shows oblique direction of clavicle and relation of clavicle to acromion; *s*, *l*, superior acromio-clavicular ligament, direction of its bundles in direction of outer curve of clavicle; acromion of quadrate type; on outer border the tubercles with intervening depressions.

Figs. 2 to 4.—Show ossification of basi-acromion from the spine, with knuckle-like projections; and stages of ossification of epi-acromion. In figs. 2, 3, and 4 the dotted parts are cartilage; fig. 2 entirely cartilaginous; in figs. 3 and 4 the ossific centres are white; in fig. 3, one small ossific centre towards anterior end. In fig. 4, seven centres; one anterior; two internal, at clavicular connexion; three external; one posterior, in caudate process of the cartilage, marked with *.

Fig. 5, ossification of epi-acromion completed, but not yet united to basi-acromion; thinner middle area between inner and outer thicker parts; thick outer part bounded by sharp line internally; posterior nucleus, *, now united to main part of epi-acromion by narrow neck, non-ossification of which would accord with form in permanently separate epi-acromion.

Figs. 6 and 6*a*, Case 3 of dissection of soft parts; separate epi-acromion on both sides; female æt. 82; left epi-acromion ossicle larger than right, but both seen to carry entire clavicular articulation; clavicular facet indicated (here and in the following figures) by line marking off a narrow crescentic area. Form of acromion between ovoid and crescentic types.

Fig. 7.—Case 6. This figure given to show case in which ossicle is shorter than usual, in proportion to basi-acromion; acromion mostly of ovoid type.

Fig. 8.—Case 7. Given to show the ossicle longer than usual, in proportion to basi-acromion; acromion of the triangular type.

Fig. 9.—Case 11. Acromion of right side; this figure given to show two epi-acromial ossicles, point of the epiphysis remaining separate from the main part; some traces of disease on this specimen.

Figs. 10 to 13.—Diagrams to show typical forms presented by the acromion process, placed in order of frequency; equal frames, with equal subdivisions, drawn to assist eye in recognising the different forms. Fig. 10, quadrate form; fig. 11, ovoid form, anterior end prolonged without angles; fig. 12, triangular type, antero-external angle deficient; fig. 13, crescentic type, posterior and antero-external angles both deficient.

III. Account of Dissections and Specimens showing separate Acromion Ossicle in the Adult.

Points to be attended to in the study of such specimens.—Careful study of the parts is essential in such an inquiry. Attention has to be given to the following:—Whether there is evidence of disease at the acromion or of the shoulder joint, or evidence of former injury. Sex, age, and robustness of the scapula. General form of the acromion and its size. In regard to the separate *ossicle*, —its length in proportion to the basi-acromion. In regard to the *intra-acromial joint*, —its direction, in relation to the longitudinal axis of the acromion; direction particularly at the outer side, whether obliquely backwards; ligaments and edges or crests at the joint, and amount of movement allowed; nature of the surfaces of the joint, whether a synovial cavity present. In regard to the *acromio-clavicular joint*,—whether the clavicle rests in part on the basi-acromion; whether the ligaments and surfaces are normal.

The following Table may be referred to for comparison of the specimens.

Table II.—*Showing the size of the separate acromial ossicle in relation to that of the entire acromion, and other particulars of each of the scapulæ; the measurements of the scapulæ given in inches, those of the ossicle in $\frac{1}{12}$ths of an inch.*

No.	Fig.	Side.	Age.	Sex.	Scapula.		Entire Acromion.		Separate Ossicle.	
					Length.	Breadth.	Length.	Breadth.	Length.	Breadth at Base.
1	.	R.	80	?	$5\frac{1}{2}$	4	$1\frac{9}{12}$	1	$\frac{10}{12}$	$\frac{10}{12}$
2	.	L.	80	F.	$5\frac{5}{8}$	$3\frac{7}{8}$	$1\frac{11}{12}$	?	$\frac{10}{12}$	$1\frac{1}{12}$
3	6a	R.	82	F.	$5\frac{7}{8}$	$3\frac{7}{8}$	$1\frac{9}{12}$	$\frac{11}{12}$	$1\frac{9}{12}$	$1\frac{9}{12}$
,,	6	L.	,,	,,	same	same	same	$\frac{10}{12}$	1	$1\frac{9}{12}$
4	.	L.	80	F.	$5\frac{1}{2}$	$3\frac{1}{8}$	$1\frac{6}{12}$	$\frac{11}{12}$	$\frac{10}{12}$	$\frac{10}{12}$
5	.	R.	64	M.	$6\frac{1}{4}$	$4\frac{1}{8}$	2	1	$\frac{11}{12}$	1
,,	.	L.	,,	,,	$6\frac{3}{8}$	same	$1\frac{10}{12}$	same	.	.
6	7	L.	.	?	6	$3\frac{6}{8}$	$1\frac{10}{12}$	1	$\frac{10}{12}$	$\frac{11}{12}$
7	8	L.	.	M.?	$6\frac{3}{8}$	4	2	$1\frac{3}{12}$	$1\frac{3}{12}$	1
8	.	L.	.	?	$5\frac{6}{8}$	4	$1\frac{6}{12}$	1	$\frac{9}{12}$	1
9	.	L.	.	?	.	$3\frac{1}{2}$	$1\frac{5}{12}$	1	1	1
10	.	L.	.	?	$6\frac{1}{8}$	$3\frac{7}{8}$	$1\frac{7}{12}$	1	$\frac{8}{12}$	$\frac{10}{12}$
11	9	R.	.	M.?	.	.	$2\frac{0}{12}$	$1\frac{3}{12}$	1 and $\frac{6}{12}$	$1\frac{5}{12}$ and $\frac{6}{12}$
12	.	L.	.	M.?	$5\frac{1}{2}$	4	$1\frac{6}{12}$	$\frac{9}{12}$	1	1
13	.	R.	.	M.?	$6\frac{1}{2}$	4	2	$1\frac{2}{12}$	$1\frac{2}{12}$	1

Explanation of the measurements, etc., in the Table.—*Scapula*, length taken between upper and lower angles; breadth taken along base of spine, vertebral border to posterior border of glenoid cavity. *Acromion*, including the ossicle, length taken along middle; breadth taken at middle of basi-acromion, generally the greatest breadth. *Ossicle*, length taken from middle of tip to middle of its joint with basi-acromion; breadth taken along base at joint, whether transverse or oblique. All the measurements are taken with callipers. As the acromion, as a whole, is bent longitudinally, convexity upwards, there falls to

be added for the length of the basi-acromion about $\frac{1}{12}$ inch more than that remaining after deducting the length of the ossicle.

The first five cases are dissections, so that the age and sex could be given. In Nos. 3 and 5 both sides are given. The other side of No. 2 was noted as normal. In No. 11 there are two ossicles, anterior and posterior, with slight marks of disease. In No. 2 the acromion was thinned by absorption. In No. 1 there had been sub-coracoid dislocation and rheumatoid disease of the shoulder joint. The remaining eight are macerated specimens. Those that are probably male are marked M. ?; those of which the sex is quite uncertain have ? in the sex column.

(A.) Dissections.

Case No. 1. Also old-standing sub-coracoid dislocation of humerus, with chronic rheumatoid arthritis of shoulder joint and great alteration of the anatomical neck of the humerus. From a subject æt. 80, sex not noted. Right scapula, left not noted.

Scapula rather undersized (length 5½ inches, breadth 4) but muscular markings pretty well developed. *Acromion*, of the broadly crescentic type; much bent, very convex at middle third at and behind intra-acromial joint; but a posterior angle present where spine meets acromion considerably internal to usual position of posterior angle. *Ossicle*, triangular, end blunt, like end of little finger, and does not project beyond clavicle. Length $\frac{10}{12}$ inch, breadth at base $\frac{10}{12}$. Entire acromion, length $1\frac{9}{12}$, breadth at middle of basi-acromion 1 inch. The ossicle shows one faint projection on outer margin and projects considerably at base. Basi-acromion shows two tubercles besides the posterior angle, one of them at the joint.

Intra-acromial joint, direction nearly transverse, undulating, has small median projection and goes backwards at both sides, most at the outer side, giving moderate backward direction to joint externally. Good superior and inferior ligaments, superior the strongest; moderate ridges above and below attach the ligaments. Movement distinct. When joint opened, synovial cavity seen throughout; surfaces ($\frac{10}{12} \times \frac{5}{12}$ inch) undulating, smooth but finely dimpled, not like ordinary articular cartilage except on most of inner half; covering of cartilage thin. The ossicle is thicker ($\frac{6}{12}$) than the basi-acromion ($\frac{4}{12}$) and rough below, but not diseased.

Acromio-clavicular joint.—Inferior ligament considerably strengthened; no inter-articular fibro-cartilage and but few synovial fringes. Cartilage on clavicle thick and mostly spongy, giving irregular surface. Acromial facet, smooth cartilage; height $\frac{4}{12}$ with the usual inclination; length $\frac{8}{12}$, of that $\frac{2}{12}$ on basi-acromion. When clavicle pushed outwards, ossicle is moved freely; when clavicle pushed outwards and backwards, the movement is arrested by the basi-acromion. Synovial cavity appears to be continuous with that of intra-acromial joint, but I am not certain of that. Coraco-clavicular band strong, attached entirely to the ossicle.[1]

Case 2.—With great thinning of acromion; shoulder joint healthy. The appearances suggest former disease of the sub-acromial bursa. From a female subject æt. 80. Left scapula, right scapula noted as normal.

Scapula, rather undersized (length 5⅝, breadth 3¾), very thin, very translucent at both fossæ; ridges on subscapular fossa well marked. Surfaces of shoulder joint, capsular ligament, and tendon of biceps healthy. *Acromion*,

[1] The condition of the shoulder joint in this case is noted in the Appendix.

may have been of quadrate type, but now has on outer border three irregular excavations with serrated edges, giving two triangular peaks between. The anterior excavation ($\frac{6}{12}$ wide, $\frac{1}{12}$ deep) is entirely on the ossicle; the middle excavation (1 inch wide, $\frac{3}{12}$ deep) has its apex at the intra-acromial joint and is more on the ossicle than on the basi-acromion; the posterior excavation ($\frac{9}{12}$ wide, $\frac{3}{12}$ deep) is on the back part of the outer border of the basi-acromion, the peak bounding it in front is opposite the middle line of the spine of the scapula. The acromion as a whole is thin on its outer half, translucent at parts, shelving outwards to a sharp edge like an oyster shell; under surface marked by shallow depressions; upper surface irregularly grooved transversely, especially on outer half opposite the excavations (thickness at the grooves $\frac{1}{12}$, at the ridges $\frac{3}{12}$ to $\frac{2}{12}$). No ostitic roughness on either surface. The peaks to which the ridges run outwards appear to represent, so far, the points to which the inter-muscular septa of the deltoid are attached. Length of entire acromion $1\frac{10}{12}$, breadth at most projecting peak $1\frac{3}{12}$. *Ossicle*, length $\frac{10}{12}$, breadth at base $1\frac{1}{12}$; the breadth in this case, if not increased by disease, thus exceeding the length.

Intra-acromial joint,—on outer two-thirds, only a loose membranous ligament, $\frac{2}{12}$ in length when stretched, connecting the thin edges of the bones; on inner third, the bones are in contact ($\frac{4}{12} \times \frac{1}{12}$) with ligament above, below and internally, are lined by thin cartilage with appearance of a synovial cavity. The ossicle is very loose in all directions, and moves outwards and inwards for $\frac{2}{12}$ inch when pushed or drawn by the clavicle.

Acromio-clavicular joint,—connexion only by a slack ligament ($\frac{1}{8}$ to $\frac{1}{2}$ inch in length, $\frac{3}{4}$ in breadth, $\frac{1}{12}$ in thickness) between the ends of the bones. Where ligament attached, ossicle $\frac{1}{4}$ inch in thickness at middle, thin before and behind, concave both ways; end of clavicle $\frac{3}{4}$ inch in breadth, $\frac{1}{4}$ in thickness at middle, excavated both ways; no adaptation between the bones possible. The ligament has no attachment to the basi-acromion. Outward dragging of the ossicle by the action of the deltoid would be checked by the acromio-clavicular and coraco-clavicular ligaments, forward dragging by the intra-acromial ligament.

Case 3. On both sides. From a female subject æt. 82. No disease on either side. Figured in the Plate, left fig. 6, right fig. 6a.

Scapulæ slender, thin and very translucent on both fossæ, ridges on subscapular fossa pretty well marked. Both scapulæ, length $5\frac{3}{8}$, breadth $3\frac{3}{8}$. *Acromion*, form on the two sides, and that of the ossicle, seen in figs. 6 and 6a. The form is between the ovoid and crescentic types, the outer border much bent at and near the intra-acromial joint, the posterior angle somewhat rounded, the anterior end blunt-pointed. *Ossicles*, triangular with blunted apex; left longer than right, forming more than half of entire acromion, the right less than half. Length of both acromions $1\frac{9}{12}$; breadths at middle of basi-acromion, right $\frac{11}{12}$, left $\frac{10}{12}$. Breadth of both ossicles at base $\frac{9}{12}$; lengths, right $\frac{9}{12}$, left 1 inch. The left ossicle, the longer one, shows two deltoid tubercles, the basi-acromion one tubercle close to the joint; the right ossicle one elevation, the basi-acromion two. There are besides the tubercles represented by the anterior and posterior angles.

Intra-acromial joint, good ligament above and below, the former rather the stronger, attached to raised edges above and below on both bones. These ligaments unite round the borders, on inner border forming a septum between the intra-acromial and the acromio-clavicular synovial cavities. Movement, though limited by these ligaments, is enough to be recognisable in the living body. Synovial cavity present on both sides throughout; surfaces not smooth and polished like ordinary articular cartilage, but finely mottled; the covering of cartilage thin. Depth of the surfaces at the middle $\frac{5}{12}$, being greater than

the thickness of the ossicle and basi-acromion ($\frac{3}{12}$), owing to the raised edges at the joint. In direction, the joints differ on the right and left sides. The way generally in the series of specimens is, that the basi-acromion forms a projection and falls away backwards on either side, giving a general concavity backwards, with, it may be, minor undulations. That is seen here on the right side (fig. 6a), the projection being external to the middle ; but on the left side (fig. 6) that on which the ossicle is the longest, it is the reverse, the projection being on the ossicle, and the outer slope of the joint has a forward instead of the usual backward direction.

Acromio-clavicular joint.—It is worthy of note that the inferior ligament, normally very slender, is stronger than usual. In both scapulæ the clavicle rests entirely on the ossicle, as shown in the figures, the connexion of the clavicle to the basi-acromion being only by the posterior part of the acromio-clavicular ligaments. Length of acromio-clavicular surfaces, $\frac{1}{8}$ inch, height $\frac{1}{8}$ inch ; length being thus the same on both sides although the left ossicle is longer than the right. In both the joint begins at the posterior part of the ossicle. Acromial facet concave both ways, clavicular facet convex both ways ; joint has the usual slope downwards and inwards. The acromial facet is lined by smooth articular cartilage. In the upper half of the joint on the right side there is a *true incomplete inter-articular fibro-cartilage*, elliptical and wedge-like (height $\frac{2}{12}$, length $\frac{1}{8}$ inch) attached above to the superior ligament, below with natural sharp edge. Its cartilage-like appearance marks it off distinctly from the fibrous tissue of the ligament from which it hangs into the joint. In the left joint it is much less apparent, about half the height of the one in the right joint, and with fringed free edge, hardly an advance on the synovial tufts that usually hang into the joint from above and are liable to be mistaken for a partial inter-articular fibro-cartilage.

Sockets of shoulder joint healthy, except some thickening of long tendon of biceps at its origin in left shoulder.

Case 4. From a female subject æt. 80. Left scapula ; no disease. Right not noted.

Scapula,—$5\frac{1}{2} \times 3\frac{3}{8}$ inches ; very thin and translucent at fossæ ; subscapular ridges very faint, but other muscular markings well developed. *Acromion*, crescentic type, posterior angle rounded off, outer border much bent at and behind intra-acromial joint ; point does not project beyond line of clavicle. Length of entire acromion $1\frac{6}{12}$, breadth of basi-acromion at middle $\frac{11}{12}$. *Ossicle*, length $\frac{10}{12}$, breadth at base $\frac{10}{12}$. Outer border shows no deltoid tubercle, but projects considerably at the base ; basi-acromion shows two tubercles, besides the posterior angle, one of them at the joint.

Intra-acromial joint, ligament above and below, attached to raised edges, joining at outer and inner sides, the inferior ligament quite as strong as the superior. Movement quite sufficient to be recognisable in living body. Synovial cavity throughout, and not continuous with acromio-clavicular joint ; surfaces ($\frac{10}{12} \times \frac{5}{12}$) same appearance as noted above in other specimens, the covering of cartilage thin and with smooth but finely mottled surface. Direction of joint, at right angles to axis of acromion, undulating but nearly transverse generally, outer fourth inclined moderately backwards.

Acromio-clavicular joint.—Clavicle rests entirely on ossicle ; connected to basi-acromion only by posterior part of ligaments. Inferior ligament, as in case 3, much stronger than normal. Facets, length $\frac{9}{12}$, height $\frac{3}{12}$, the acromial one concave both ways, the clavicular one convex both ways ; have the usual slope downwards and inwards. Surface of acromial facet smooth and polished articular cartilage, that of clavicular facet smooth but tending to spongy condition. *A complete inter-articular fibro-cartilage* present, with completed synovial cavity on each side of it. It is attached all round, below to the clavicle rather than to the ligament ; is about $\frac{1}{24}$ inch in thickness, semi-translucent, but firm enough to maintain the curvatures that had adapted it to the

facets. This is the only instance of the occurrence of a complete inter-articular fibro-cartilage at this joint I have ever seen.

The socket of the shoulder joint is healthy ; also the tendon of the biceps.

Case 5. From a male subject æt. 64. Right scapula ; no disease. Some appearance of corresponding groove on left acromion.

Length of right *scapula* 6½ inches, of left 6⅝ ; breadth of both 4⅛ ; both have strong muscular markings. *Right acromion*, form rather of the oval type, posterior angle rounded, anterior end a blunt point projecting a little (⅛ inch) beyond clavicle, outer border considerably convex at and near intra-acromial joint. Length 2 inches, breadth of basi-acromion 1 inch. *Ossicle*, length $\frac{10}{12}$, breadth at base 1 inch. Outer border of ossicle shows a low elevation and projects considerably at the base ; basi-acromion shows two deltoid tubercles, one near the front and one in front of the rounded angle.

Intra-acromial joint.—Ligament above and below attached to raised lips ; the lips above considerably raised, suggesting slight ostitic action here. Amount of movement allowed should be quite recognisable in living body, especially depression. Synovial cavity throughout ; surfaces, as noted in previous cases, smooth and mottled and layer of covering cartilage thin. Surfaces, 1 inch by ½ inch ; upper crest and greater convexity above give unusual height to the surfaces. Thickness of basi-acromion and of ossicle $\frac{4}{12}$, thickness (height) at the raised lips $\frac{7}{12}$. Direction of the joint, nearly transverse, with slight general concavity of basi-acromion ; no backward direction of joint at outer side.

Acromio-clavicular joint.—Clavicle rests entirely on ossicle, posterior part of ligaments alone connecting clavicle to basi-acromion. Inferior ligament stronger than usual. Facets, length $\frac{7}{12}$, height $\frac{4}{12}$; acromial concave both ways, clavicular convex both ways ; joint has usual slope downwards and inwards ; cartilage of both smooth, that of clavicle thicker, showing tendency to spongy condition. Synovial tufts hang into joint from above, simulating a partial fibro-cartilage, but are only ragged tufts.

Left acromion.—On upper surface a shallow groove crosses the acromion in nearly same position as the intra-acromial joint of right acromion, almost exactly in same position except that it bends back at the outer and inner sides. Is best marked on inner half, its sharp posterior boundary prolonged from upper edge of spine of scapula. As the groove is not deep and as there is no groove or mark on the under surface, I hesitate to consider it a vestige of the union of a formerly separate ossicle, but it may be so. Acromio-clavicular joint of left side, same as noted on right side. Form of acromion, like the right, but wants the considerable convexity of outer border seen on the right acromion at and near the intra-acromial joint. Of same breadth as the right, it is $\frac{2}{12}$ shorter, which might accord with the disappearance of a former intra-acromial joint. Of three tubercles seen on outer border of acromion between anterior end and posterior angle, two are in front of the groove, one of these close to it ; the third is behind the groove on what would have been the basi-acromion.

(B.) Macerated Specimens.

The following are macerated specimens in my collection, with the exception of Nos. 12 and 13, which are in the Charles Bell collection in the Museum of the College of Surgeons. They are all adult. The sex can be only inferred from the size and muscularity, and consequently appears in the Table (Table II.) as either entirely uncertain or as probable. Of these eight specimens six

are of the left side; there is no record of the condition of the other side.

Case 6. Fig. 7. Left scapula; no appearance of disease.

Scapula, length 6 inches, breadth $3\frac{6}{8}$, muscularity moderate. *Acromion* mostly of the ovoid type, posterior angle rounded, length of entire acromion $1\frac{10}{12}$, breadth at middle of basi-acromion 1 inch. *Ossicle*, length $\frac{10}{12}$, breadth at base $\frac{11}{12}$. Two of the tendon tubercles seen on the ossicle, the second of these at its base; basi-acromion scarcely shows a tubercle. *Intra-acromial joint*, line wavy, general direction nearly transverse to axis of acromion, but outer third directed obliquely backwards. *Acromio-clavicular joint*, facet for clavicle, length $\frac{9}{12}$, of which about a fourth part is on basi-acromion. The figure (fig. 7) is given as an example of the partial resting of the clavicle on the basi-acromion, although that is not owing to shortness of the ossicle.

Case 7. Fig. 8. Left scapula; no appearance of disease. From size and muscularity inferred to be probably male.

Scapula, length $6\frac{6}{8}$ inches, breadth 4; muscular. *Acromion*, of the triangular type, antero-external angle wanting, antero-internal angle very pointed and prolonged a little ($\frac{1}{8}$ inch) beyond clavicle; length of entire acromion 2 inches, breadth of basi-acromion $1\frac{2}{12}$. *Ossicle*, long; length $1\frac{3}{12}$, being longer than basi-acromion by $\frac{1}{2}$ inch; breadth at base 1 inch. Tendon tubercles on outer border of ossicle rather indefinite, but appearance of two, and base projects; one tubercle, perhaps two, on basi-acromion, besides its angle. *Intra-acromial joint*, line sigmoid, on basi-acromion concave internally, convex externally, then directed a little backwards; general direction a little outwards and backwards. Lips of joint project a good deal above. *Acromio-clavicular joint*, facet entirely on ossicle, length fully $\frac{9}{12}$ inch; is about $\frac{1}{8}$ inch from base and from apex of ossicle.

Case 8. Left scapula; no appearance of disease.

Scapula, length $5\frac{6}{8}$ inches, breadth 4; apparently aged, fossæ very translucent and muscular ridges little marked. *Acromion*, like No. 7, of the triangular type, considerable convexity on outer border at the joint; length of entire acromion $1\frac{6}{12}$, breadth of basi-acromion 1 inch. *Ossicle*, length $\frac{9}{12}$, being equal to that of basi-acromion, breadth at base 1 inch. The considerable convexity on outer border at and near joint appears as if formed by a tendon tubercle on each bone; anterior tubercle on ossicle indefinite; posterior angle of basi-acromion fairly well marked. *Intra-acromial joint*, general direction outwards and a little backwards; inner two-thirds wavy, obliquely backwards at inner side; outer third obliquely backwards till at margin. *Acromio-clavicular joint*, facet entirely on ossicle; length $\frac{6}{12}$, height $\frac{3}{12}$; extends from near base of ossicle to $\frac{3}{12}$ inch from point; surface foraminated. Both basi-acromion and ossicle thin in this apparently aged specimen.

Case 9. Left scapula; no appearance of disease.

Scapula, part below spine and glenoid cavity has been sawn off; breadth $3\frac{1}{2}$ inches; muscular markings on spine moderate. *Acromion*, mostly of the ovoid type, posterior angle well defined behind but not very prominent, outer border considerably bent at the joint. Length of entire acromion $1\frac{8}{12}$, breadth of basi-acromion 1 inch. *Ossicle*, length 1 inch, being longer than basi-acromion by $\frac{1}{8}$ inch; breadth at base 1 inch. On its very convex outer border two low tendon tubercles seen and base projects. Slight tendon tubercle seen at middle of short basi-acromion. *Intra-acromial joint*, angular, inner third directed backwards, outer two-thirds backwards till just at margin, general

direction backwards and outwards. *Acromio-clavicular joint*, facet entirely on ossicle, might seem partly on basi-acromion but not so, triangular area behind it is foraminated and facet seen to be finished at back part of ossicle ; length of facet $\frac{7}{12}$, height at middle $\frac{4}{12}$; at front of facet ossicle slopes off to blunt apex ; direction of facet mostly downwards and outwards (not inwards).[1]

Case 10. Left scapula ; no appearance of disease.

Scapula, length 6½ inches, breadth $3\frac{2}{8}$, narrow for its length ; not muscular. *Acromion*, of the crescentic type, posterior angle quite rounded off obliquely, only a very low projection to mark off acromion proper from expanding crest of spine ; outer margin uniformly convex, antero-external as well as posterior angle wanting, giving the crescentic form ; anterior end pointed but not sharp ; length of entire acromion, $1\frac{8}{12}$, breadth of basi-acromion 1 inch. *Ossicle*, length $\frac{8}{12}$, breadth at base $\frac{10}{12}$. Two low tendon tubercles on ossicle and projection at joint ; on basi-acromion one tubercle besides projection at joint. *Intra-acromial joint*, angular, outer third directed moderately backwards, inner two-thirds directed more obliquely backwards ; upper edges considerably raised. *Acromio-clavicular joint*, facet rests partly on basi-acromion, height $\frac{4}{12}$, length $\frac{7}{12}$, of which $\frac{1}{12}$ is on basi-acromion ; anterior end is $\frac{3}{12}$ from point of ossicle.

Case 11. Right scapula ; two ossicles, anterior and posterior, leaving the acromion in three pieces ; traces of chronic arthritis on under surface of the ossicles. Fig. 9.

Scapula, only outer portion with the processes and outer part of clavicle present ; evidently a strong muscular scapula. *Acromion*, of the crescentic type, posterior angle moderately rounded, outer margin uniformly convex, pointed in front, giving crescentic form. Length of entire acromion $2\frac{0}{12}$ inches, of which $1\frac{6}{12}$ formed by basi-acromion ; breadth of basi-acromion $1\frac{3}{12}$. *Two epi-acromial ossicles ; posterior*, length 1 inch, breadth at base $1\frac{1}{12}$; *anterior*, length $\frac{5}{12}$, breadth at base $\frac{6}{12}$, triangular and pointed at end. *Posterior intra-acromial joint*, general direction outwards and forwards, wavy, slopes backwards more at inner than at outer side. *Anterior intra-acromial joint*, general direction nearly transverse. Tubercles on outer border of acromion indefinite, two on basi-acromion besides posterior angle, the front one at the middle, and projection at joint ; one on posterior ossicle besides projection at base, but border serrated ; tubercles on anterior ossicle represented by point and by projection at base. *Acromio-clavicular joint*, clavicle rests entirely on posterior epi-acromial ossicle ; posterior part of ligaments attached to basi-acromion, anterior part attached to base of anterior ossicle.

Amount of diseased appearance.—On upper surface, edges of both intra-acromial joints raised more than usual and surface of posterior ossicle rather rough ; on under aspect, posterior ossicle has smooth polished "porcellanous" surface finely foraminated, anterior ossicle a little rough but not porcellanous.

---

[1] *Note on ossification of the supra-scapular ligament.*—In evidence that there was no want of tendency to ossification in this scapula, may be noted that the supra-scapular ligament is represented by a strong bridge of bone, ½ inch in breadth. In three other scapulæ in my collection having this bridge of bone (all from different subjects), one, a left, has the bridge as broad as in case 9 ; in the other two, right scapulæ, the bridge is only about ⅛ inch in breadth. In one of the latter the foramen is elongated and slightly hour-glass shaped, and would take in both the nerve and the bloodvessels ; in the two with the broad ridge not more than the nerve could pass through. These bridges of bone, usually described as resulting from ossification of the ligament, are quite smooth bone.

No other appearance of disease; glenoid cavity healthy and tendon of biceps normal.

The subdivision of the epi-acromion in this case might have been attributed to disease had there been marked arthritis, but as the shoulder joint is healthy and as the appearance of disease seen on the posterior ossicle is not great, the conclusion appears to be that we have here a case in which the ossific centres for the anterior part of the acromion have remained separate as well as a case in which the major epi-acromion has remained separate from the basi-acromion.

I am indebted to the Museum Committee of the College of Surgeons for permission to notice the two following specimens, Nos. 12 and 13.

Case 12. Left scapula showing separate epi-acromion, and appearance as if of united fracture at lower angle and base of bone. No appearance of disease.

The specimen, No. 3, 102 in the printed catalogue, is marked "Ununited fracture of the acromion process and united fracture of the vertebral border." In the MS. catalogue of Sir Charles Bell the description is, "There has been a fracture of the acromion scapulæ; a false joint must have been formed between the two portions; at the lower angle a fracture, or perhaps a diastasis of the cartilage, has taken place, which is now united." I mention this to show the view that used to be taken of the nature of this condition of the acromion. The acromion, however, presents the usual family likeness of cases of separate epi-acromion.

Scapula, moderately muscular and of good size, length 5¼ inches, breadth 4 (somewhat diminished by the supposed fracture). The line of the seeming fracture cuts off ½ to ¾ inch at lower angle and about ½ inch of the breadth of the base up to nearly midway to the spine. The united part is inclined to the subscapular fossa, and the fracture thus appears to have been caused by a force from behind. No appearance of other injury to the bone and none of disease. *Acromion*, form indefinite, between the crescentic and triangular types, posterior angle much sloped off, almost continued from lower edge of crest of spine, anterior end blunt-pointed, general triangular form given mainly by form and great size of epi-acromion. Length of entire acromion $1\frac{6}{12}$, of which only the $\frac{6}{12}$ formed by basi-acromion; breadth $\frac{5}{12}$. *Ossicle*, length 1 inch, breadth at base (the broadest part of entire acromion) 1 inch. Tubercles on outer border of acromion indefinite, one elevation on epi-acromion, a slight one on basi-acromion, and both have projecting angles where they meet at the joint.

Intra-acromial joint, general direction transverse, but with concavity backwards; margins a little raised except on ossicle below. *Acromio-clavicular joint*, entirely on ossicle, facet on ossicle ovoid and short, length $\frac{6}{12}$, height $\frac{3}{12}$, situated $\frac{3}{12}$ from posterior end of inner border of ossicle, $\frac{4}{12}$ from anterior end; has very little inclination downwards and inwards.

Case 13.—Right scapula in which a formerly separate ossicle is now mostly united to the basi-acromion. This specimen is exceptionally interesting as showing union taking place. No appearance of disease.

In the original Bell catalogue the specimen is marked as "A fracture of the acromion scapulæ." In the valuable recent printed catalogue, 1893, by the

Conservator of the Museum, Mr Cathcart, it is marked "No. 3, 103. Supposed fracture of the acromion process of the scapula. Right scapula—macerated—showing an irregular groove between the acromion process and the rest of the bone. This is possibly a late union of the epiphysis."

Scapula large and muscular, in all probability male; length 6½ inches, breadth 4. *Acromion*, of bluntly crescentic form, inner border very little concavity, external border uniformly convex, anterior end blunt, posterior angle very little marked. Length of entire acromion 2 inches, breadth 1 1/12. *Ossicle*, length 1 2/12, breadth at base 1 inch. Tubercles on outer edge of acromion, on the ossicle two besides point and corner at suture; on basi-acromion, one very low tubercle at middle, and corner at suture.

Intra-acromial suture, direction nearly transverse, slightly outwards and backwards; nearly straight. The suture of union is strongly marked above, as a furrow about 1/12 inch wide and nearly the same in depth; its anterior boundary sharp and overhanging, the posterior boundary bevelled with slightly raised margin; floor of furrow shows a few fine foramina. On under surface only a shallow furrow seen, with corresponding direction.

Acromio-clavicular joint.—A very small part of the facet, hardly 1/12 inch, is on the basi-acromion; length of facet 8/12, height 1/12, distance from anterior end of inner border of ossicle 3/12.

The probable interpretation in this case is that the union of the epi-acromion has been delayed. If it has been a case of fracture, the fracture has taken place at the usual line of epiphysial union, and is undergoing bony union without callus.

IV. Consideration of the Causes of the Condition of Separate Acromion Process.

Fracture. Relation to Chronic Rheumatoid Arthritis. Relation to the Epiphysis.

It is not easy to find one's way to definite conclusions on these relations amid the numerous and conflicting opinions to be found in the literature of the subject.[1]

[1] General statements in the Text-books of Surgery need not be referred to when not bearing evidence of being founded on personal observation. The following are the writings of authors more particularly referred to:—The late *Prof. Robert Adams*, of Dublin—(*a*) "Shoulder Joint, Abnormal Conditions of," in *The Cyclopædia of Anatomy and Physiology*, vol. iv., article written in 1849; and (*b*) *Treatise on Rheumatic Gout*, 2nd ed., 1873, with accompanying vol. of Plates. The late *Prof. Robert W. Smith*, of Dublin, "Observations upon Chronic Rheumatic Arthritis of the Shoulder," in the *Dublin Quarterly Journal of Medical Science*, February and May 1853. *Mr John Gregory Smith*, "Pathological Appearances in Seven Cases of Injury of the Shoulder Joint, with Remarks," in *The London Medical Gazette*, vol. xiv., 1834. *Mr W. Arbuthnot Lane*—(*a*) "Some Points in the Physiology and Pathology of the Changes produced by Pressure in the Bony Skeleton of the Trunk and Shoulder Girdle," in *Guy's Hospital Reports*, vol. xliii., 1886; (*b*) "The Causation and Pathology of the so-called disease Rheumatoid Arthritis, and of Senile Changes," in *Transactions of the Pathological Society of London*, vol. xxxvii., 1886; and (*c*) "Mode of Fixation of the Scapula, etc.," in the *British Medical Journal*, 19th May 1888. *Prof. F. H. Hamilton*, of New York, *Practical Treatise on Fractures and Dislocations*, 8th ed., revised and edited by Prof. Stephen Smith, of New York, 1891.

(A.) Fractures of the Acromion.

Question of frequency. Distinction between true fracture and conditions simulating fracture.

The impression that fracture of the acromion process is not a very common occurrence appears to be conveyed by *Sir Astley Cooper's* opening words on this fracture in his celebrated *Treatise on Dislocations and Fractures of the Joints*—"This point of bone is sometimes broken." But from the remarks that follow, in regard to the detection of the fracture, it is evident that this great surgeon and anatomist was familiar with the occurrence. He speaks of diminished roundness of the shoulder, of feeling the depression on tracing from the spine to the clavicle, and of crepitus being felt when the surgeon places his hand upon the acromion and rotates the arm. In the accompanying dorsal diagrammatic figure (p. 411, new ed., 1842) the line of fracture has the family likeness to the specimens I have described of separate acromion. Of the second figure given (p. 412), he says:—

"This figure shows a fractured acromion; the edges of the fractured surfaces are united by ligament, part of which has been turned aside to show ligamentous granulations upon the fractured surface." No history is given for the preparation. The figure is a front view, and it also has the family likeness to my specimens. He adds—"Fracture of the acromion may unite by bone; but it generally unites by ligament, in consequence of the difficulty which exists in producing adaptation and in preserving the limb perfectly at rest during the period required for union." He does not allude to fracture without displacement, and consequently assumes difficulty in producing adaptation.

It is not evident but that his remark just quoted, as to non-union being general, may be founded on dissecting-room specimens of separate acromion. He makes no reference to the epiphysis.

Sir William Fergusson, writing some years later (*Practical Surgery*, p. 185, 1842), says:—

"The acromion process may be broken, but the accident is of rare occurrence. I have dissected a number of examples of apparent fracture of the end of this process; but in such instances it is doubtful if the movable portion had ever been fixed to the rest of the bone." In the figure he gives to show "the ordinary position of some of the fractures here referred to," the line on the acromion gives more to the broken off part than in my specimens, but the figure is diagrammatic.

Thus Fergusson, thorough surgical anatomist as well as experienced surgeon, was in doubt whether such specimens should be regarded as cases of fracture or as cases of non-union of the epiphysis.

Prof. Adams, under the head of "Fracture of the acromion process" (*loc. cit., a*, p. 600), remarks:—

"The fracture of the acromion will be generally found to have taken place at a point behind, and within, the junction of the clavicle with this bony process; its direction we always observe to be in the original line of the junction of the epiphysis with the rest of the bone."

No cases are given, and the above remark is too general. He is probably influenced by his favourite view, alluded to below, of separation taking place at the line of junction of the epiphysis in cases of chronic rheumatic arthritis; and in his subsequent references to the opinions of Sir A. Cooper and Malgaigne the reader is left in doubt whether the remarks of these authors are founded on museum specimens, such as those described in this paper, or on cases ascertained to have been traumatic fractures.

The view expressed by *Prof. F. H. Hamilton* (*loc. cit.*, p. 199), a recognised authority on fractures and dislocations, may be taken as his judgment on the evidence submitted by previous writers as well as embodying his own experience, and they have largely influenced modern writing and teaching on this question.

"There is some reason to believe, I think, that a true fracture of the acromion process is much more rare than surgeons have supposed, and that in a considerable number of the cases reported there was merely a separation of the epiphysis; the bony union having never been completed. If such fractures or separations occurred only in children, very little doubt might remain as to the general character of the accident; but the specimens which I have found in the museums, and the cases reported in the books, have been mostly from adults. It is more difficult, therefore, to suppose these to be examples of separation of epiphyses, but I am inclined to think that in a majority of instances such has been the fact. It is very probable, also, that in the case of many of the specimens found in the museums, called fractures, the histories of which are unknown, they were united originally by cartilage, and that in the process of boiling, or of maceration, the disjunction has been completed. The narrow crest of elevated bone which frequently surrounds the process at the point of separation, and which Malgaigne may have mistaken for callus, is found upon very many examples of undoubted epiphyseal separations which I have examined; and this circumstance, no doubt, has tended to strengthen the suspicion that these were cases of fracture."

"There is no doubt, however, that a fracture of this process does occasionally take place. Examples of fracture of the acromion process have been reported by Duverney, Bichat, Avrard, A. Cooper, Desault, Sanson, Nélaton, Malgaigne, West, Brainard, Stephen Smith, and others. *I have myself seen five cases.* In the case seen by Cooper it *entered the articulation of the clavicle*, and produced at the same moment a dislocation. Malgaigne says it occurs *generally* further up, and *posterior to the attachments of the clavicle*, 'near the junction of the diaphysis with the epiphysis,' and that the fracture is in most cases transverse and vertical; but Nélaton saw a case in which the fracture was oblique. In the case reported by C. West, of Hagarstown, Md., the fracture was *through the base of the process.* In *two* of the examples seen by me the fracture was *in front of the clavicle;* in the *third*, occasioned by the fall of a barrel of flour upon the shoulder, the fracture occurred *at the acromio-clavicular articulation*, and was accompanied with an upward dislocation of the outer end of the clavicle; in *the fourth*, the fracture occurred *at the same point*, but there was *neither displacement of the clavicle nor of the process*, the fracture being only recognised by crepitus and motion. The *fifth* was brought to my notice by Dr Sabine, surgeon to Bellevue Hospital. The patient had been struck by a policeman's club. There was distinct crepitus, the fracture being *posterior to the acromio-clavicular junction*, but there was *no displacement* of the fragments or of the clavicle. Some of the fractures were confirmed by dissection, and in the case mentioned by Dr Stephen Smith, an autopsy, made three weeks after the accident, showed a fracture *in front of the clavicle without displacement*, the periosteum covering its upper surface not being torn; the fragment could be

turned back as upon a hinge. [This fracture was caused by a blast; a fragment of rock being driven upward struck the acromion on the under surface.]"

I have placed some of the words in the above quotation in italics in order to call attention to the localities of the fracture. In the five cases of undoubted traumatic fracture that came under Hamilton's personal observation, two of them (and Dr Stephen Smith's case) were in front of the clavicular connexion; two of them at the acromio-clavicular articulation (meaning, we may infer, opposite some part of the articulation); in the fifth case the fracture was behind the clavicular connexion. There was no displacement in one of the cases (the fourth) in which the fracture occurred opposite the clavicular connexion, nor in the one (the fifth) behind that connexion, nor in Dr Stephen Smith's case where it occurred in front of the clavicle. From this undoubted, though limited, statistic we see that traumatic fracture may occur at any part of the acromion, depending, no doubt, on the kind and locality of the force; further, that there may be no displacement, but that, notwithstanding, the existence of the fracture may be detected by careful examination.

These references sufficiently show that in the opinion of Hamilton traumatic fracture is a comparatively rare occurrence, so that, although alive to the question and expert in the mode of its detection, he could, in his wide experience, refer to only five cases of the occurrence.

In strong contrast with the usually accepted opinion of Hamilton, is that of *Mr Arbuthnot Lane*, of Guy's Hospital, who holds that fracture of the acromion process is the most common of all fractures. In 325 bodies whose bones he carefully examined in the dissecting-room (*loc. cit., c*, 1888, p. 1048), while he found no instance of undoubted fracture of the coracoid process, he "found that a considerable proportion presented fractures of the acromion, that portion of the scapula being broken more frequently than any other bone in the body." He refers to the statistics of fractures of the upper extremity treated at the Middlesex Hospital in ten years ending 1879, a total of 1084 fractures, of which 6 were of the coracoid process and only 10 of the acromion. This contrast to his own finding in the dissecting-room he attributes to "the comparative difficulty in detecting a fracture of the acromion. I have in many instances of so-called simple contusion of the shoulder of the living subject been able to satisfy myself of the presence of an ununited fracture of the acromion or of fracture of the outer third of the clavicle."

In a previous paper (*loc. cit., a*, 1886) Mr Lane includes a full consideration of the question of the frequency of fractures of the acromion. The paper is an elaborate and thoughtful one, embracing the consideration of the trunk and shoulder girdle, and contains much original matter with pretty strong criticism of the views of

other writers. Mr Lane's paper is a valuable contribution to the discussion of the interpretation of the condition of separate acromion process, but requires to be read critically. He assumes too readily that all such specimens, whether with or without the accompaniment of rheumatoid arthritis, were originally cases of fracture, and he appears not to be aware of the frequency of the occurrence of the separation at the locality of the union of the epiphysis.

Experimenting on the dead body, Mr Lane finds (p. 408):—

"If the outer end of the shoulder as represented by the acromion be struck vertically, obliquely, or at right angles to the vertical by a light hammer the acromion is fractured with the greatest facility. This fracture usually corresponds in position with the seat of fracture as found pathologically, and its direction will be found to vary within the same limits. In this artificial fracture the line of fracture may pass in front of or behind the oval clavicular facet or through any portion of its area. Using the same light hammer, but with greater force, the clavicle may be broken. It is broken much more easily in that portion of its extent which lies outside the conoid tubercle."

Referring to his observation of the bones in numerous subjects in the dissecting-room, Mr Lane says (p. 415):—

"I found a great many instances of fractures of the acromion, but did not consider this unnatural, judging from the facility with which I was able to break the acromion with a blow applied horizontally as in a fall on the shoulder, or vertically as when the shoulder is struck by a falling body. In many of those in which the fracture was in front of the clavicular facet I found considerable displacement of the fragments. The direction and seat of the fracture varied within a broad limit, corresponding to the direction of the fractures I obtained experimentally on the dead body. In some cases the fragments were connected by intervening fibrous tissue, while in other cases they were united by a fibrous capsule lined by a synovial membrane. The latter arthrodial joint allowed of much more freedom of movement than the amphiarthrodial joint, and the extent of development present in the newly-formed articulation was evidently dependent on the amount of movement to which it had been subjected by the occupation of the individual and to a less degree upon the direction and seat of the fracture."

"In almost all these cases *the shoulder joints presented the changes which are usually described as rheumatoid arthritis*, but which I think are better described as *pressure changes*. These, I am convinced, must have been consequent on the injury that caused the fracture of the acromion, so that the fracture and the joint changes were both expressions of the blow received, which was the cause of both."

It will have been observed by the critical reader that in these quotations there is a good deal of theory and general statement, and ready assumption that all of the separate acromions found in the dissecting-room had been cases of fracture. It need not be doubted that the acromion may be readily broken in the dead body, or that it may, and probably is, often broken in the living body, at any place; but the question is, Why the separation is so often found just behind the clavicular connexion, at the place of union of the epiphysis, and how that is to be explained; and as bearing on the supposed connexion with rheumatoid arthritis it is necessary to be informed in each case to what extent the head of the humerus had eburnated or excavated the acromion.

Mr Lane notes (p. 416) five museum specimens, all of which he assumes to have been traumatic fractures, and which he regards as "fair instances of ununited fracture of the acromion."

In Nos. 1, 3, and 4 there are "extensive so-called rheumatoid changes in the shoulder joint," but to what extent the under surface of the acromion was eburnated or excavated is not stated. The lines of separation are various in position and direction. They proceed outwards:—In No. 2, "from a point behind the clavicular facet. The surfaces of the fragments are smooth and eburnated, and are connected by a capsule lined by synovial membrane. The glenoid cavity presents but slight change." In No. 4, "from a point just behind the clavicular facet. The union is by dense ligamentous tissues. There is no displacement of fragments." In No. 5, "outwards and backwards from a point just in front of the clavicular facet. The fragment is displaced somewhat downwards and forwards. The surfaces are united by dense ligamentous tissue." In No. 1, "outwards from just behind the anterior margin of the clavicular facet. The outer fragment is connected to the acromion by ligamentous tissue; there is no synovial cavity. It is displaced forwards in a horizontal plane." In No. 3, "outwards from the centre of the clavicular facet. There is no displacement, and the fragments are united by dense ligamentous tissue."

It will be observed that in the two cases first quoted (Nos. 2 and 4) the *line of separation* was just behind the clavicular facet, the position at or close to which it occurred in all of the thirteen cases I have described, being the locality of the union of the epiphysis. The other three cases, from the localities of the separation, could only be cases of true fracture.

In explanation of the *displacement* noted in Nos. 1 and 5, Mr Lane remarks (p. 421):—

"The forward displacement of the fragment when the fracture occurs outside or through the anterior portion of the clavicular facet is due to the gradual contraction of the coraco-clavicular ligament which draws it downwards and forwards."

That may be, but the unresisted dragging down of that portion of the deltoid muscle would seem a better explanation. That there may be no displacement when the fracture is in front of the clavicle is seen in Dr Stephen Smith's case, above referred to. The periosteum was not torn, as probably enough it is not in most cases of fractured acromion; accounting for their being so often overlooked. There is no displacement in any of the thirteen specimens I have described; open to the alternative interpretation of epiphyseal separation or of fracture. On the latter supposition, if the action of the deltoid muscle and the contraction of the coraco-acromial ligament should cause displacement of a fractured anterior part of the acromion, would we not much more expect displacement in fracture at the post-clavicular line? The whole acromio-clavicular connexion is then detached from its basi-acromial support, the scapula now hung to the clavicle only by the coraco-clavicular ligaments, as in fractures near the outer end of the clavicle, in which considerable displacement is often enough seen.

Mr Lane notes two specimens of *united* fracture of the acromion (p. 417), both presenting evidence of severe injury to the shoulder.

In the first, there is also "an unreduced sub-coracoid dislocation of the head of the humerus;" in the second, the head of the humerus "is much deformed and shortened." In the first, "Its direction is outwards from *the centre of the clavicular facet*. The fracture has united firmly by bone. There is considerable horizontal displacement of the outer fragment, the angular intervals between it and the inner fragment being filled in by osseous material." In the second, "The direction of the fracture is outwards from a point *a quarter of an inch behind the clavicular facet*. The outer fragment slopes downwards and outwards. There is more callus uniting the fragments on the lower than on the upper surface of the fracture."

These appear to have been cases of true fracture, and followed by bony union. There was some displacement in both. In explanation of the occurrence of bony union in these two cases, Mr Lane says—"The complete rest of the parts necessitated by the more severe injury to the shoulder-joint in both these cases has permitted of the fragments of the acromion being kept sufficiently at rest to allow of their uniting by bone."[1]

---

[1] To these I may add a case resembling the first of these two which, since writing the above, I have come upon in examining a preparation of old-standing unreduced sub-coracoid dislocation of the shoulder in the Charles Bell collection in the Museum of the Edinburgh College of Surgeons. The case has the further interest in that both shoulders had been dislocated. In the *left* shoulder (Cat. of 1893, p. 192, No. 5, 3), a spirit preparation that must have been put up more than sixty years ago, I find there has been fracture of the acromion with bony union; in the *right* shoulder, a dried preparation (No. 5, 4), the acromion is entire. As there is no history during life, it may be inferred that they were met with in the dissecting-room.

In the original MS. Bell Catalogue, the *left side* is described thus:—"Both arms of this man had been dislocated; on this side, the left side, the scapula has also been fractured through its body. The posterior portion has been dragged forwards by the action of the serratus magnus muscle, and the two portions have united irregularly; the newly formed joint of the shoulder is exposed." The *right side* is thus described:—"The right scapula and humerus from the same body as the preceding preparation, articulated as they were found in the body. There was dislocation inwards with fracture of the inner edge of the glenoid cavity. Imperfect anchylosis has taken place between the posterior part of the body of the humerus and that portion of the glenoid cavity which was fractured and was again united. The surfaces of the head of the humerus and of the glenoid cavity are both rough and unnatural, having for a long period before the patient's death been deprived of their office as a joint."

Both specimens show abundant evidence of rheumatoid action following the dislocations. They are true sub-coracoid dislocations, each with definite new glenoid cavity. The *right acromion*, a good-sized quadrate acromion, stands out prominently and is uninjured and healthy. The *left acromion* has been fractured just behind the clavicular connexion, the line directed outwards and a little forwards. There is no displacement. That there had been fracture I infer from the presence of a furrow on the upper surface and outer edge, about $\frac{1}{8}$ inch in breadth and $\frac{1}{15}$ to $\frac{1}{10}$ inch in depth; and on the under surface from the presence of a callus-like ridge externally and internally with a furrow at the middle between them. These ridges led me to look for further evidence of fracture. The furrow above was seen only after removing the periosteum. The under surface of the acromion also was covered with periosteum. There is firm bony union.

In regard to the supposed rarity of the occurrence of fracture of the acromion, Mr Lane refers to the fact, above noted, that in the statistics of fracture treated at the Middlesex Hospital for ten years ending 1879, there were recognised only ten cases of fracture of the acromion; of which one occurred during the first five years of life, one between 15 and 30, four between 30 and 45, and the remaining four in patients above 45 years of age. And he remarks (p. 420):—

"These facts, taken in conjunction with the frequency with which this fracture is observed in the dissecting-room, and the facility with which it is artificially produced in the dead subject, serve to show *that in the living subject fractures of the acromion process are hardly ever diagnosed.*"

In support of his opinion that specimens of separate acromion have been cases of fracture, as opposed to the non-union of the epiphysis view, Mr Lane gives the following six reasons (p. 418):—

Against the possibility, as he expresses it, "that the bony centre in the extremity of the epiphysis has formed with the remainder of the bone an arthrodial or amphiarthrodial joint, as in the manubrio-sternal articulation and in the joint which usually exists between the body and cornua of the hyoid bone, I would put forward the following arguments:

1. The frequency with which it occurs associated with other fractures of the shoulder-girdle and its connexions, where it is extremely probable, if not absolutely certain, that it owed its presence to the same cause. In some of these cases an amphiarthrodial joint, with or without displacement, is present, while in others an arthrodial joint, with or without forward, or forward and downward, displacement exists.
2. The frequency of its association with so-called rheumatoid arthritis of the shoulder-joint, which I consider to be as much an expression of injury as fracture.
3. Its much greater frequency on the right side.
4. The broad limit in the space in which this condition is found. It may occur outside the clavicular facet or a considerable way inside.
5. The variation in the direction of the fracture with respect to the axis of the acromion.
6. The fact that the seats of this condition and those of fracture artificially produced differ in no single particular."

In view of the facts and arguments submitted by Mr Lane, it is not possible to resist the conclusion that fracture of the acromion process is a much more frequent occurrence than had been supposed, or than is usually stated in text-books on surgery, and that the erroneous impression is owing to the difficulty in detecting the fracture, or, rather, to the readiness with which it may be overlooked. He is, however, not on so sure ground in holding that the "hypothesis of separation of the epiphysis" is "utterly without foundation." He fails to account for the fact that, while fractures of the acromion may occur at any part, the usual place of separation is at or close to the post-clavicular line, the place of union of the epiphysis. That may be from his not having seen so many cases of its occurrence at that locality as I and others

have seen. That is the locality in all of the thirteen cases I have described, and I have not seen a specimen of its occurrence at any other part of the acromion. While not doubting that true fractures of the acromion occur at and in front of the clavicular connexion and that they may remain in the ununited condition, the fact that the usual locality of separate acromion is at the post-clavicular region remains for some anatomical explanation.

One of Mr Lane's list of reasons above quoted, the third, that has not been met in the preceding considerations, remains to be noticed:—"Its much greater frequency on the right side." That was so among the six cases noted by him; all of the five specimens given as of ununited fracture of the acromion were of the right side, while only the case of united fracture, accompanied by dislocation of the shoulder, was of the left side. The argument seems to have weight, taken along with the consideration that accidents to the upper limb, including dislocations of the shoulder, are more common on the right than on the left side. But turning to the facts given in my Table II., page 10, it is seen that of my 13 specimens, 8 were of the left side, 3 of the right side, 1 of both sides, and 1 (Nos. 5 and 6) certainly on the right side, doubtfully on the left. To these falls to be added the Charles Bell case (given in the footnote above) in which, with dislocation of the shoulder on both sides, the acromion had been fractured on the left side but not on the right. These numbers reverse Mr Lane's conclusion, and show the danger of founding a general conclusion on a limited statistic.

(B.) Question of the Cause of the Occurrence of Separate Acromion Process in Cases of Rheumatoid Disease of the Shoulder Joint.

This co-existence was prominently brought into notice by the late Prof. Robert Adams of Dublin (*loc. cit.*), to whom, and to the late Prof. Robert W. Smith of Dublin (*loc. cit.*), surgery was indebted for original and valuable observations on the condition termed by Adams "chronic rheumatic arthritis," now usually called chronic rheumatoid arthritis.

The literature of the subject of chronic rheumatoid arthritis is extensive, and has involved the discussion of the occurrence of so-called "dislocation upwards" of the humerus, and the question is complicated by the frequent association of the rheumatoid condition with the appearances of old traumatic dislocation of the humerus forwards or downwards. Mr Adams labours to establish that the displacement upwards is not to be taken as primarily traumatic but as a secondary result of the rheumatoid disease, and that such secondary displacement may also take place inwards or downwards. Confusion has arisen from the term "new glenoid cavity" being vaguely or variously used. But it is

easy to determine that a specimen is one of old traumatic dislocation by the presence of a defined new glenoid cavity placed to the inside of or below the old cavity, sub-coracoid or sub-glenoid, where the dislocated head of the humerus had worked for itself a new cavity before the rheumatoid changes were set up. The new glenoid cavity so often mentioned by Adams is the space acquired upwards, by the gradual destruction of the capsular tendons and other soft parts, at length formed by the coraco-acromial arch and the old glenoid cavity together.

It is hardly necessary to say that traumatic dislocation of the humerus upwards is an anatomical impossibility unless the acromion process has been fractured and displaced upwards. The upper end of the humerus, cushioned by the capsular muscles, fully occupies not merely the glenoid cavity but also what may be called the accessory socket of the shoulder joint, formed by the coraco-acromial arch. The sub-deltoid bursa alone intervenes between the cushioned ball and the acromion, serving as the synovial membrane of the accessory socket, the space intervening when the parts are exposed in dissection being enough to admit only the end of the handle of the scalpel when pushed into it. Rupture of the long tendon of the biceps muscle might possibly cause some hitch in abducting the arm, but that secondary function of the tendon is exercised only when the biceps muscle is acting, and the former supposition that that rupture is a not infrequent occurrence is now well known to have arisen from a misinterpretation of the condition in which the tendon is usually found in cases of advanced rheumatoid disease.

The supposition that the rheumatic tendency has had the effect of delaying the union of the acromial epiphysis would imply that the rheumatic tendency had shown itself in early life, by the age of about the 25th year, and it is not evident why that tendency should single out the acromial epiphysis among all the epiphyses of the skeleton. The relation, if not due to injury causing fracture, must be sought in some operation of the advancing rheumatoid disease of the shoulder joint, effecting a separation of an already united epiphysis.

In the advanced stages of that disease there is great alteration of the parts, especially upwards, as well described by Adams. The capsular tendons are more or less completely absorbed, the upper part of the capsular ligament is more or less destroyed, allowing the head of the bone to pass upwards to contact with and friction against the coraco-acromial arch ; the cartilage of the glenoid cavity and of the head of the humerus is more or less destroyed and replaced by eburnation, both socket and head are altered in shape and osteophytes and cartilaginous excrescences form ; a large general socket results, embracing the altered old glenoid cavity and the supra-glenoid sub-acromial space, this capacious cavity embraced by a capsular ligament, the upper part

of which may be attached to the coraco-acromial arch, the lower part of it to beyond the anatomical neck of the altered humerus; and the cavity is filled with fluid and with synovial fringes and cartilaginous excrescences projecting into it. The long tendon of the biceps muscle may be in process of absorption but is generally gone within the joint and has acquired a new attachment to the humerus at the bicipital groove, from which that head of the muscle continues to exercise its function.

These extensive changes are well depicted by Adams in his Plate ii. and in Plate iii., fig. 2 (*op. cit., b*). In regard to the upward passage of the humerus and its effect on the coraco-acromial arch he says (*loc. cit., a*, p. 587):—

"Under the influence of the most usual form of this disease, all these parts intervening between the head of the humerus and the coraco-acromial arch or vault are absorbed; and the superior extremity of the head of the humerus at length comes into immediate contact with the concavity of the arch . . . its head being constantly pressed against the under surface or concavity of the coraco-acromial arch, not only do the processes of the scapula which form this arch at length show manifestly the effects of friction, but the upper portion of the acromial end of the clavicle does so equally. All these portions of bone are rendered concave, and are usually covered by a porcelain-like deposit, corresponding to an analogous polished surface which covers the convexity of the head of the humerus.

"In many cases in which the shoulder joint has long been the seat of this chronic disease, the *acromion process* has been found traversed in the line of junction of its epiphysis by a complete interruption of its continuity, *as if fractured:* we say as if fractured, for we are convinced that this solution of continuity of the acromion process is not really a fracture produced by violence, but a lesion, which so frequently exists in combination with chronic rheumatic arthritis of the shoulder, that we are compelled to look upon it, in these cases, as a peculiar organic change, the result of chronic rheumatic disease. We do not pretend to account for the separation of the acromion process into two portions; nor can we say why it is that the division usually occurs in the original line of the epiphysis, particularly at the late period of life at which we generally witness this phenomenon. In some of these cases we have found the acromion in a state of hypertrophy; in others in a state of atrophy; but in no case did there seem to be any attempt at ossific deposition on the contiguous surface of the separated portions of the acromion, a circumstance which might be expected if a fracture had occurred."

As Adams says in *many* cases, it is worth while to inquire whether the association of separate acromion process with chronic rheumatoid disease is in reality a frequent occurrence. I have therefore made the following note of the number of such cases that have been recorded, so far as I am aware, noting at the same time whether there is evidence of the case having begun with an injury to the joint such as would account for fracture of the acromion process. An important point to note is, whether the acromion was separate in both shoulders. The condition of chronic rheumatoid disease, as Adams remarks, is frequently symmetrical, and the theory of fracture is not very likely to be applicable in cases of symmetrical separate acromion.

Enumeration and particulars of cases in which separate acromion process was found associated with the condition of chronic rheumatoid disease of the shoulder joint.

1. By *Adams* (*loc. cit.*, *a*, p. 590, fig. 429). Case of J. Byrne, male, æt. 55. Chronic rheumatoid disease of right shoulder for some years (no mention of left). When arm was raised humerus could be felt to strike against acromion. On post-mortem examination all the parts that lie normally between humerus and coraco-acromial arch had completely disappeared. Outer end of clavicle and the coracoid worn and excavated. *Acromion process* traversed from within outwards by a perfect solution of continuity, completely dividing it into two nearly equal portions, the two portions on same level, no ossific deposit at the separated edges. Same case figured in *loc. cit.*, *b*, Plate iii., fig. 2.

2. By *Adams* (*loc. cit.*, *a*, p. 588). Sex and side not mentioned. Specimen of advanced rheumatoid disease in Museum R.C.S. Dublin. Acromial end of clavicle unsupported, *acromion process* "removed" to extent of an inch, remainder of process thinner than natural and atrophied. This specimen shows that continued friction of the end of the humerus had led to absorption of the part of the acromion that is sometimes found separate.

3. In *Sandifort's Museum Anatomicum*, vol. iv., Table 25, fig. 2, referred to by Adams (*loc. cit.*, *a*, p. 599, fig. 431; also figured by Adams in *loc. cit.*, *b*, p. 163). Right side. Sandifort considered the condition of the parts to be the result of accident. Adams considers it a case simply of chronic rheumatic arthritis, and remarks—"The *acromion process* is divided into two portions; a phenomenon we have so frequently noticed to accompany this disease of the shoulder joint."

4. By *R. W. Smith* (*loc. cit.*, p. 12, figured in Pl. ii.). Side not mentioned and not evident from figure. "It was taken from the body of a woman of advanced age, who for many years suffered from the usual symptoms of this disease, and who, it was known, had never sustained any injury of the shoulder." As described, the changes on the soft parts and on the bones at the shoulder joint are the usual characters above noted of advanced chronic rheumatoid disease. "Upon removing the deltoid muscle the naked head of the humerus, elevated to the acromion process, came into view. . . . The *acromion*, about ¾ inch from its extremity, was divided into two portions which were held together solely by the fibrous structure which invests the upper surface of the process; but this tissue was so stretched that the detached portion was separated from the remainder of the acromion by an interval of ¾ inch. The under surface of the entire process was denuded of periosteum and covered with an ivory-like structure, which was also found investing the articular surfaces of the acromio-clavicular joint." The condition of the acromion in this case approaches that described in my Case No. 2, in which, however, there was no disease of the glenoid cavity.

5. By *R. W. Smith* (*loc. cit.*, p. 1, Pl. i., fig. 1). Male, æt. about 60. Case of *congenital* dislocation on dorsum of scapula in *both* shoulder joints, "in which chronic rheumatic disease had been established." Glenoid cavity situated on external aspect of neck, and no vestige of glenoid cavity in normal situation. Head of humerus "placed much further back than natural, and elevated so as to be in contact with the under surface of the acromion process." Disease much the same on both sides, but *acromion process* separate on right side only, on left side perfect. The separation of the right acromion is at about an inch from its anterior end; no deposition of bone along the line of separation; no displacement; the detached portion closely connected to the remainder of the process by fibrous tissue.

Here we have clearly a case of original malposition of the head of the humerus, serving for sixty years of life, in which there is at least no record of injury to account for the rheumatoid disease found in both shoulders. Although there was the "elevation to the acromion process," there apparently

was not naked contact of the head of the humerus with the acromion, as the tendons of the capsular muscles were perfect except that of the subscapularis, which had partially disappeared ; and the capsular ligament was present, somewhat thicker than natural. The tendon of the biceps was present. There were osseous growths around the large glenoid cavity, and great changes on the form of the head of the humerus, with eburnation. As the soft parts were present between the elevated humerus and the acromion, it would, on the whole, seem most reasonable to suppose that the separation of the right acromion had been due to some injury causing fracture.

6. By *R. W. Smith* (*loc. cit.*, p. 353). Owing to the loose way in which the cases are brought in, it is not at first evident that this was not the case No. 4 above noted, but on critical study it is seen to be a different case, and both sides are described. Female, age not given, "the patient laboured under the disease in both shoulder joints for several years before her death, but the affection had been established in the right articulation long before the left was attacked." Both sides show the changes in much advanced rheumatoid disease. The *acromion* separate on *both* sides, the detached portion at a considerable distance from the basi-acromion. On the *left* side—"The head of the humerus (with the intervention of the capsule) was pressed closely against the under surface of the acromion, which process, about $\frac{3}{4}$ inch from its extremity, was divided into two portions separated fully $\frac{1}{2}$ inch from each other, the fibrous structure which connected their upper surfaces having suffered a corresponding amount of elongation. The detached portion, along with the extremity of the clavicle, was also pushed upwards above the level of the remainder of the process."

On the *right* side, figured in Pl. iii., the changes were more advanced. "About $\frac{3}{4}$ inch of the extremity of the *acromion* had altogether disappeared, and a broad, thick, concave plate of bone passed downwards from the shortened process, and became perfectly continuous with the upper and outer part of the margin of the glenoid cavity, which thus appeared as if a coracoid process had sprung from its external side. The acromial extremity of the clavicle was enlarged, excavated upon its under surface, and polished by the attrition of the head of the humerus ; it was distant from the acromion fully $\frac{3}{4}$ inch, but connected to it by an exceedingly dense fibrous tissue, which constituted the highest part of the capsule." The upper attachment of the capsule was transferred to the acromion, clavicle, and coracoid process, and was thin, "in many places as translucent as if it had been composed merely of synovial membrane." The tendons of the capsular muscles were flattened and expanded and detached from the humerus. The view here conveyed seems to be that the separate piece of the acromion had been floated down and become attached to the upper and outer edge of the glenoid cavity ; and the author connects with this a reference to a preparation in the Dublin R.C.S. Museum, somewhat similar in other respects, of which Adams says "the acromial end of the clavicle is unsupported, and the acromion process has been removed for the amount of an inch in extent."

In this case it is seen that the capsule still intervened, but was very thin on the left side, allowing of close contact and pressure against the acromion, the side on which the detached acromion had suffered greatest displacement. Apart from the supposition of former injury to both shoulders, causing fracture, it appears not unreasonable to agree with Smith that the detachment of the acromions was a consequence of the ravages of the disease.

7. By *Mr John Gregory Smith* (*loc. cit.*, p. 280). Case in which the *acromion was separate on both sides.* Dissecting-room specimen, female, æt. 56. A short, stout, muscular subject, had worked at wash-tub up to time of sudden death. Appearances described are those of chronic rheumatoid disease of both shoulder joints, moderately advanced. No history to the case, but the author assumes "fracture." On *right* side—"There was an oblique fracture of the *acromion process* of the scapula, which had separated about an inch of its expanded extremity; it had not united by bone, but had formed an artificial joint

through the medium of cartilage, and was further strengthened by a fibro-ligamentous capsule." Sub-deltoid bursa communicated with cavity of shoulder joint by an irregular opening. Tendons of subscapularis and supraspinatus detached from their insertions and united to capsule. Tendon of biceps gone within joint. Under surface of acromion eburnated. On *left* side—"The *acromion process* of the scapula had been fractured precisely in the same situation as that of the opposite side, and formed a similar artificial joint." Sub-deltoid bursa much enlarged and thickened and communicated with shoulder joint. Tendons of subscapularis and supraspinatus partially detached from their insertions. Biceps tendon gone within joint, attached, as on right side, at bicipital groove.

Mr Gregory Smith's paper, 1834, is entitled "Pathological Appearances of seven cases of Injury of the Shoulder joint; with Remarks." The seven cases were in *five* subjects (two being in both shoulders) dissected in the Hunterian School of Anatomy. No previous history bearing on the nature of the cases, except that given in the one above related. His case 1 was a man, only left shoulder described; case 2, a woman æt. 30, only left side described; case 3, a woman æt. 38, only right side described; cases 4 and 5, that above given, with separate acromion on both sides; cases 6 and 7 (right and left shoulders of same subject), a man æt. 40. The appearances, well described, in all of them are those of the havoc wrought in the shoulder joint by chronic rheumatoid disease. The author assumes previous injury to the shoulder, apparently not acquainted with the characters presented in advanced rheumatoid disease, or with the question regarding separate acromion process. In only one of them (No. 7, above) was there separate acromion, but in one (his case 1) there was fracture of the outer end of the clavicle "which extended into its articulation with the acromion." These cases by J. G. Smith may be taken, simply, as well-marked cases of chronic rheumatoid disease, arising either from some supposed former injury, or, as held by Adams and R. W. Smith, as arising independently of injury; but in the one in which separate acromion occurred the precise symmetry of the separation is remarkable.

8, 9, 10, 11. Four of the specimens mentioned by *Mr Lane* (*loc. cit.*, *a*, p. 415 and p. 417). One (p. 415, side, sex and age not given) with great alteration of the head of the humerus and glenoid cavity. "There is also an ununited fracture of the *acromion*. Its direction is backwards and slightly outwards from a point a quarter of an inch internal to the clavicular facet." Adams and R. W. Smith would regard this case as one of advanced rheumatoid disease; Mr Lane regards the condition of the parts as "evidently produced by a fall on the shoulder." The fracture of the acromion, if fracture it was, is at a little behind the clavicular connexion, the usual situation in cases of separate acromion.

The other cases mentioned by Mr Lane (p. 417) are three of the five above referred to, given by him as "fair instances of ununited fracture of the acromion," in three of which there were "extensive rheumatoid changes in the shoulder joint." To one of these (the fourth of the five cases), as the separation was just behind the clavicle, the epiphysis theory would apply; but not to the first, in which the line of separation was just behind the front of the clavicular facet; nor to the third, in which the line was opposite the centre of the clavicular facet. These, therefore, are two cases in which separation of a part of the acromion co-existed with extensive rheumatoid changes, but in which fracture was the probable explanation, the injury that caused the fracture also setting up the rheumatoid condition.

12. The case No. 1, described by me in this paper. Subject æt. 80, case of old-standing sub-coracoid dislocation of the humerus with extensive rheumatoid disease of the shoulder joint (condition of latter noted fully in Appendix). Line of separation $\frac{1}{8}$ inch in front of the posterior end of the clavicular facet. In this case the injury that caused the dislocation would readily account for a fracture of the acromion. The separation, however, is very close to the place at which it is usually found. My case No. 11, showing two separate ossicles,

might also be included in this list, as showing some little rheumatoid disease at the acromion, but the glenoid cavity is healthy.

Interpretation of the preceding cases. Explanation of the co-existence.

Adams and R. W. Smith are eager to prove that such cases are not cases of what various authors had described as partial dislocation upwards, arising from injury, in which the long tendon of the biceps had been ruptured; but are cases of chronic rheumatic arthritis, in which the displacement upwards was secondary, from the gradual destruction of the soft parts, leading to pressure of the humerus on the coraco-acromial arch and detachment of the acromion process. That position they may be said to have fully established as against the view of original traumatic dislocation upwards, with or from rupture of the biceps tendon, and as showing that extensive changes of the soft parts and of the bones are the result of long-standing rheumatoid disease. But they rather fail to satisfy that the rheumatoid condition may not have arisen, in at least some, perhaps in most, of their cases from an injury which at the same time had been enough to cause fracture of the acromion process, though not to cause dislocation of any kind. They have also been rather led away by the supposed frequency of the co-existence of separate acromion process and rheumatoid disease of the shoulder joint. Of the 12 cases above enumerated of that co-existence they had seen only the first six, and in addition could refer only to the seventh; and although they dwell on the occurrence of symmetry in the coincidence, the fact is that in only two of these seven cases (Nos. 6 and 7) was the acromion found to be separate in both shoulders. Considering the frequency of the occurrence of rheumatoid disease of the shoulder, their use of the term "many," as applied to the coincidence of separate acromion is, therefore, an exaggeration. Thus R. W. Smith, following Adams, says (*loc. cit.*, p. 355):—

"Among all the numerous and varied phenomena which occur during the progress of chronic rheumatic arthritis of the shoulder, there is none more remarkable, nor one for which it is more difficult to offer any satisfactory explanation, than the detachment of the extremity of the acromion process. It is most frequently to be noticed in the advanced stages of the disease, but I have more than once seen it at a period prior to the destruction of the tendon of the biceps; it is in many instances symmetrical, and in general occurs where in early life the epiphyses joined the remainder of the process. I have, however, in one instance found the entire of the acromion thus separated from the spine of the scapula. It may co-exist either with hypertrophy or atrophy of the acromion; it may occur with or without perforation of the capsular ligament; or with absorption in some instances, and displacement in others, of the tendon of the biceps, or finally in cases where the tendon is perfect as to structure and normal as to position."

In regard to the detachment of other epiphyses than that of the acromion, R. W. Smith says (*loc. cit.*, p. 356):—

"By those who have not made the subject of chronic rheumatic arthritis a special object of their study, it might be supposed that the singular solution of continuity of the osseous tissue, such as that to which I have been alluding, was only to be met with in the acromion process. This, however, is far from being the case, for I have seen half of an hypertrophied olecranon thus separated from the shaft of the ulna, in an aggravated case of this disease affecting the elbow joint, and in several instances of chronic rheumatic arthritis engaging the articulation of the knee, which are preserved in the Museum of the Richmond Hospital, large portions of the condyles and head of the tibia may be seen separated from the remainder of the bone. In one of these examples the detached mass is of such size as to embrace the insertion of the ligament of the patella."

I leave it to surgical pathologists to say whether they find such separations of epiphyses a frequent occurrence. The following is R. W. Smith's recondite suggestion in the endeavour to account for separation of epiphyses taking place (*loc. cit.*, p. 357):—

"It would appear from the analytical investigations conducted by Mr Harper, and recorded by Mr Canton, that in this rheumatic disease of the shoulder a large proportion of the earthy matter naturally existing in the bone is removed; but I scarcely deem the knowledge of this fact adequate, of itself, to account for the solution of continuity in the acromion; and it appears to me that, in our endeavours to explain this remarkable phenomenon, we can at present only go so far as to suppose that, under the influence of this specific arthritic inflammation, the intimate structure of the bones undergoes some peculiar molecular alteration, the exact nature of which is as yet hidden from us, but the effects of which are to diminish its cohesive power, and to render it liable to yield to a pressure, which, though perhaps not powerful, is increasingly exerted upon it. In many of these cases I have found the affected bones soft, porous, and spongy: these conditions in some instances co-existing with increase of volume, constituting that state of the osseous tissue which Lobstein (*Traité d'Anatomie Pathologique*, tom. ii.) has described under the title of 'Osteoporosis.'"

Mr Lane, in the second paper referred to (*loc. cit., b*, 419), disposes summarily of the view of Adams and R. W. Smith, adopted by F. H. Hamilton, and repeated in English text-books of surgery—"That many of the specimens which have been regarded as ununited fractures of the acromion are really separations of the epiphysis"—holding that such cases have been the result of some injury causing fracture of the acromion, the injury afterwards setting up the rheumatoid condition.

In this thoughtful paper Mr Lane mentions that he is struck, as every one who has been long in dissecting-rooms must have been, with the great frequency with which so-called rheumatoid disease is seen, especially in old subjects. He regards the condition not as a "disease," but as the result of pressure in over-use or disuse, influenced by occupation, or it may be lighted up by injury; modified by the vitality of the individual, the changes atrophic in feeble persons and by osteophytic growth or eburnation in powerfully-built hard-working men.

He says (p. 389), "I think I have succeeded in proving that most of the changes which are defined as indications of the presence of the so-called disease rheumatoid arthritis are purely physiological and in no way the product of any disease. They consist chiefly of what might be called accommodation changes."

Treating of "changes in the shoulder joint" in feeble old age (p. 437), Mr Lane speaks of gradual upward displacement of the humerus irrespective of rheumatoid changes. Partial atrophy of the supra-spinatus and of the upper parts of the other capsular muscles; extension of the articular surface of the humerus to the rotated-out and partially altered greater tuberosity; the ascent of the latter to the acromion, separated only by the muscles and capsule. The force that brings this about is, he says, that of the traction of the coraco-brachialis and biceps and deltoid muscles in the unused limb. That these are senile changes without rheumatoid appearances, but not often seen in the dissecting-room, as "the class from which our old subjects is drawn is one which is very much exposed to injury in every form." On this he concludes (p. 441):—

"I have now proved that the upward dislocation of the head of the humerus can and does take place without the presence of changes which are regarded as characteristic of rheumatic gout. I have also shown that injury to the shoulder-joint which has resulted in fracture of the acromion is always followed by the development of rheumatoid changes, and that these rheumatoid changes may be produced in the shoulder joint without any upward dislocation from injury to the shoulder in which the acromion has not been fractured."

Referring to the upward changes in the advance of the rheumatoid condition, Mr Lane says (p. 419):—

"As the head ascends, it rasps and destroys by its pressure the muscles that intervene between it and the under surface of the acromion, while they themselves tend to degenerate owing to the limited power of abduction in old age. Reaching the acromion the functional pressure exerted by the rough surface of the head of the humerus causes destructive changes in it, the periosteum being removed and the subjacent bone rubbed down and eburnated."

This clear description leaves us at the stage when, according to the separation theory of Adams, the detachment of the acromion should be effected, and it is not unreasonable to suppose that that detachment should be a further result of these "destructive changes" if it is the fact that the line of junction of the epiphysis is anatomically a weak point of the acromion. At the same time, on the supposition of fracture being the explanation, the question remains,—Why should the fracture be so often at that part corresponding to the place of junction of the epiphysis, and just behind the acromio-clavicular articulation?

V. Anatomical Considerations in relation to the usual locality of the Separation.

(A.) Strength of the Acromion at different parts.

If the under surface of the acromion is examined in a series of scapulæ it is seen that the *sub-acromial beam*, continued from the thick external border of the spine, spreads out as a smooth thickening upon about the posterior third of the acromion. The ridge varies a little in its sharpness, and in its distance from the posterior angle, the latter according to the degree of development of the posterior angle, but the expanded beam gives thickness and transverse convexity to the posterior third of the acromion, and the surface of that part is smooth. In front of this the inferior surface is concave in both directions and more or less foraminated, and the thickness is considerably less. The transverse concavity, generally present, is increased by the lip at the outer border to which the prolongation of the coraco-acromial ligament and the deepest part of the deltoid muscle are attached; and, internally, by the usually slightly projecting lip of the clavicular facet. The distinction between these two regions on the under surface of the acromion is on a line from the posterior end of the clavicular facet outwards and backwards to some way in front of the posterior angle of the acromion, the distance depending on the development of that angle, and the line marks off, stated generally, the posterior third of the acromion from what may be called the clavicular, or anti-clavicular, region of the acromion. The line of demarcation is not always striking to the eye, but is generally so, in some acromions very much so, owing to the change from the smooth convex region to the foraminated concave region.

On the *upper surface* the distinction strikes the eye less; the part corresponding to the foraminated region of the under surface is more foraminated than on the posterior third, but the foraminated area is more encroached on by the raised smooth outer part for the deltoid attachment than on the under surface.

When the thickness of the acromion is taken at where the sub-acromial beam has spread into the general thickening, and at where the foraminated region has begun, the thinning at the latter is found to be considerable. An average thickness of 9 millimeters at the former has fallen to an average of 7 millimeters, a diminution of about $\frac{1}{12}$ inch. This line of demarcation corresponds to where the epiphysis has united, and if there is such a thing as detachment of an already united epiphysis from the ravages of advanced rheumatoid arthritis, it is where we might expect the acromion to give way. On the other hand, if the numerous museum specimens of separate acromion are to be interpreted as ununited fractures, we have no less an explanation

of the fracture being so often at that locality. Anatomically it is the weak point of the acromion.

In regard to the possible detachment of this part of the acromion in advancing rheumatoid disease, if the epiphysis has not yet united, the disintegration of the intervening layer of cartilage might be expected, but the rheumatoid condition is generally one belonging to advanced life. Due time being allowed for the consolidating process, here, as elsewhere, no traces remain of former distinctness; the transition of the cancellous architecture is gradual. In the variously cut sections of the acromion in my collection there is no definite difference in the internal structure at or near the place of union. The enclosing lamina of dense bone above has become very thin opposite the clavicular facet; that below, rising as a thick lamina from the sub-acromial beam, is more marked than the upper and is prolonged somewhat further than the upper lamina. The areolæ of the cancellous tissue are smaller and more rounded in the anterior than in the posterior half of the acromion, and in the latter than in the spine, but there is no abrupt change at the post-clavicular line. Any weakness of the acromion here is to be sought, not in traces of the consolidation of the epiphysis, but in the above noted thinning of the acromion at this part. This thinness would account for the acromion giving way in advancing rheumatoid disintegration here rather than further back, but not for its giving way at the post-clavicular region more than in any part of the clavicular region, along which the thinness of the acromion continues to be as great.

(B.) Influence of the clavicular connexion in determining the locality of Separate Acromion.

The connexion with the clavicle appears to me to be the most important consideration in endeavouring to explain why the locality of the separation is usually at the post-clavicular line and also why the separation is usually permanent; and that whether the cause is fracture, or epiphyseal non-union, or detachment by rheumatoid disintegration. This part of the acromion is bound to the clavicle and is supported by it; while just behind this, where the support ceases, the acromion is thinner than it is a little further back. For these two reasons combined the post-clavicular line may be regarded as the weak point of the acromion. Then, when the separation is once established, the pushings of the clavicle against the acromion, as may be seen by a glance at Fig. 1 (page 9), must tend to prevent non-union and render the separation permanent.

While, as noticed above, fracture of the acromion may occur occasionally at any part of the process, the fact is that in all of the 13 specimens described in this paper, and they are not picked cases, the line of separation is at or close to the posterior end of

the clavicular facet. They have all a family likeness, and for this the anatomical reason just given appears to account satisfactorily.

Of the 13 specimens, the clavicular facet was entirely on the separate acromial ossicle in 8, the line of separation just behind the facet. Figs. 6 and 6a (p. 9), show this most usual position of the separation just behind the facet, and symmetrically so, although one ossicle, the left, is longer than the other. In one (No. 7, fig. 8) the line of separation is about $\frac{1}{8}$ inch behind the facet; in one (No. 12) $\frac{3}{12}$ inch behind a very short ($\frac{6}{12}$ inch) facet. In one (No. 2) the atrophied ossicle was loosely connected, but there was no connexion of the clavicle to the basi-acromion. The position of the joint a little in front of the hinder end of the facet, occurring in four of the specimens, is more interesting, as giving the clavicle a rest on the basi-acromion. In two of these (Nos. 10 and 13) $\frac{1}{12}$ inch of the facet was on the basi-acromion, the facets, respectively, of $\frac{7}{12}$ and $\frac{8}{12}$ inch in length.

In one (No. 6, fig. 7) about a fourth part of a $\frac{9}{12}$ inch long facet, and in No. 1 a fourth part of an $\frac{8}{12}$ inch long facet, were on the basi-acromion. As the latter was in one of the dissections, I was able to test the effect of that on the movement of the ossicle by the clavicle. When the clavicle was pushed outwards the ossicle was freely moved, when the clavicle was pushed outwards and backwards the movement was arrested against the basi-acromion. Thus, in the ordinary movements of the shoulder, the fact of a small part of the facet being on the basi-acromion does not prevent the clavicle from causing movement of the ossicle, and thus causing the false joint in the case of fracture or maintaining a separate acromion from whatever cause arising. The connexion of the clavicle to the basi-acromion by the posterior part of the acromio-clavicular ligaments, present in all the dissections except in case No. 2, did not prevent the movement of the ossicle, free enough to be recognisable in the living body on careful examination.

Applying these considerations to the case of *fracture*, we see that, in whatever way the force comes, the anterior part of the acromion is supported by the clavicle, the force taking effect at the post-clavicular line. A stroke from above by a limited weapon will break the acromion at the part struck; but when struck broadly, or when the force is transverse as in a fall on the shoulder, it is manifest that the natural part for the giving way to take place is at the post-clavicular line. If fracture is to be accepted as the interpretation of the numerous specimens of separate acromion seen in the dissecting-room and in museums, we have thus a fair explanation of the separation being usually at or close to the post-clavicular line, and a good reason for the separation being rendered permanent by the constant pushings of the clavicle against the detached part of the acromion.

It appears reasonable to regard the clavicular connexion as having an influence also in relation to the *non-union of the epiphysis*. The post-clavicular line corresponds to the line of meeting of the epiphysis with the basi-acromion. Indeed, the position and extent of the epiphysis may be regarded as being in adaptation to the clavicular connexion. In young persons, up to about the 25th year, the same kind of injury that produces fracture in the adult consolidated acromion is still more likely to fracture the intervening layer of cartilage, and the movements of the parts will

maintain the separation and lead to the formation of a diarthrodial joint, as in fracture through the bony tissue of the adult. That, of course, is "fracture" (diastasis), but facilitated by the position of the epiphyseal line.

But apart from injury, the connexion to the clavicle might be regarded as a possible cause of non-union of the epiphysis, in the constant transverse force in the abutting of the clavicle against the epiphysis; that either in persons of feeble constitution or in young persons of exceptional activity, and the same cause would continue the separation. Apart from the continual operation of forces causing movement, we see a familiar instance of non-union continuing through life, if it passes the usual period of union, in the permanence of the suture between the right and left frontal bones of man; and in those mammals in which that is the normal condition we see that when forces operate, as in those of them that have horns, the suture becomes dentated. The influence of movement from natural forces in converting anywhere a synarthrodial into a diarthrodial joint is not to be overlooked. The theory of delayed union and naturally perpetuated non-union might be employed to account for separate acromion being symmetrical; but that is a rare occurrence, while, if the theory were well founded, separate acromion ought to be a very frequent occurrence, either symmetrically, or, if on one side only, much more frequently on the right side than on the left.

The supposed influence of *rheumatoid disease* in causing separate acromion must be taken to operate differently, according as it occurs before or after the union of the epiphysis. If before union, the rheumatic tendency might be supposed to delay the union, thereafter perpetuated by the same tendency or by the movements of the parts, and it should be symmetrical; but the rheumatic condition is comparatively rare in early life. Were advancing rheumatoid disease to find the epiphysis still not united, it might be supposed to attack first the intervening cartilage and thus detach the acromion, but advanced rheumatoid disease is a condition belonging to middle life or old age. If after consolidation, from the excavation of the acromion in the advanced stage of rheumatoid arthritis, the support given by the clavicular connexion should, perhaps, render the post-clavicular line the readiest part to suffer, being the place also where the forward thinning of the acromion has begun. The argument for this cause, that rheumatoid disease of the shoulder joint is often symmetrical, and that this accounts for symmetrical separate acromion, is met by my case No. 3, in which there was no rheumatoid disease, and by the fact that only two cases of the co-existence have been recorded. As against this theory, too, there is the consideration that advanced rheumatoid disease of the shoulder joint is of frequent occurrence but that the co-existence of separate acromion is exceptional. Considering that rheumatoid disease often follows on some injury,

as we see so often in old-standing cases of unreduced dislocation of the humerus, one cannot avoid the suspicion that the occasional co-existence of separate acromion with rheumatoid disease of the shoulder joint has been due to some injury which had fractured the acromion and led on to the rheumatoid condition.

VI. General Considerations.

(A.) Relation to Sex, Age, and Side.

In regard to *sex* we would expect fracture, and also rheumatoid disease, to be most frequent in the male, but the above cases, so far as certain, do not show that preponderance. Among my 13 cases, of the 4 dissections in which the sex had been noted, 3 were female (Nos. 2, 3, and 4), 1 male (No. 5). Of the 8 dried specimens, 4 seem from their robustness to have been males, the other 4 uncertain. Of the 6 cases of Adams, R. W. Smith, J. G. Smith, and that in the Sir Charles Bell collection above noted, 3 were in males, 3 in females.[1]

[1] Statistics relating to sex and age are liable to be influenced by a variety of circumstances. Thus, of the two schools in which I have taught anatomy; in one, the female subjects preponderated, the ratio of female to male being as about 3 to 2; while, in the other, the proportion was nearly the reverse; so that, in a total of 1200 of which I have record of the sex, the sexes came to be almost exactly equal. A more interesting statistic, as showing the basis for dissecting-room observations, is that giving the ages as well as the sex. For this I can give a statistic of only 890, as in some the precise age was not known and for about 240 the record of the age is not now available. I give the ages in five-year periods. It is seen that the number between the ages of 5 and 15 is small; that the number is large between the ages of 55 and 75, giving ample ground for advanced rheumatoid arthritis; and that after the age of 65, females preponderate, very much so after the age of 75.

Ages inclusive.	Total.	Male.	Female.	Ages inclusive.	Total.	Male.	Female.
1 to 5	37	18	19		432	213	219
6 „ 10	3	1	2	51 to 55	52	30	22
11 „ 15	7	3	4	56 „ 60	80	41	39
16 „ 20	32	14	18	61 „ 65	72	41	31
21 „ 25	56	36	20	66 „ 70	86	38	48
26 „ 30	73	29	44	71 „ 75	70	33	37
31 „ 35	46	22	24	76 „ 80	54	18	36
36 „ 40	63	30	33	81 „ 85	28	8	20
41 „ 45	46	23	23	86 „ 90	11	2	9
46 „ 50	69	37	32	91 „ 95	5	1	4
	432	213	219		890	425	465*

* This apparent preponderance of females is owing to my not now having the ages of those in the earlier years in the school in which males preponderated. Of the 1200 of which I have record of the sex, the sexes are almost exactly balanced.

In regard to proportions of sex derived from *hospital* statistics it is to be borne in mind that the male patients are more numerous than the females in

As regards *age*, when noted, it is seen in Table II. that, of my 13 cases, the first four had reached the 80th year, three of them females; the fifth case was æt. 64, male; Adam's case (*loc. cit.*, *a*, p. 590), æt. 55, male; R. W. Smith's case (*loc. cit.*, p. 1), æt. 60, male; and J. G. Smith's case, æt. 56, female. It is to be kept in mind that a considerable proportion of the subjects in the dissecting-room are elderly or old, and, in regard to the first four of these cases, that among the aged subjects females preponderate.

I find no distinct record of a case of separate acromion occurring in a young person at the place of union with the epiphysis. Reference is made above, from Mr Lane, to the ages of the ten cases of fracture of the acromion recognised and treated at the Middlesex Hospital in the ten years ending 1879; one within the first five years of life, one between 15 and 30, four between 30 and 45; the remaining four above 45 years of age. But no definite information is given as to the locality of the fracture.

Side.—Reference is made above to the fact that of the 14 cases given by me 3 were on the right side, 9 on the left side, 1 on both sides, and 1 certainly on the right side, doubtfully on the left. Adding to these the cases quoted (Mr Lane, 5 right, 1 left; other authors, 3 right, 2 on both sides), we have a total of 11 on the right side, 9 on the left side, 3 on both sides, and 1 doubtfully on both sides, but certainly on the right. That is a much less preponderance on the right side than we would expect on the fracture theory, when the greater exposure of the right limb to accidents

general hospitals, even in the physicians' wards. In our great hospital here the proportion is as 4 to 3, and in the hospital of the other school in which I taught the predominance of the male patients was in about the same proportion.

Looking to the general proportion of the sexes, the statistics of the Registrar-General for Scotland, for the year 1895, show in regard to births that for every 100 females there are 105·2 males, but that after about the age of 10 years females preponderate in the population, the disproportion increasing as years go on, the ranks of the males thinned by emigration, the army, the sea, and greater exposure to accident and the causes of disease. Although in the total deaths females preponderate (total in Scotland, in 1895, 81,864, males 40,726, females 41,138), the proportion is reversed in the case of deaths in the large towns (males 5511, females 5382.) Dr Blair Cunynghame, of the Registrar-General's Office, Edinburgh, has kindly given me the following figures showing the proportion of women to men in the two towns to which my anatomical statistics refer. In Edinburgh, with a total population of 261,225 (census of 1891) there were 22,715 more females than males, being a ratio of 119·05 females to every 100 males. In Aberdeen, with a total population of 124,943, there were 9803 more females than males, being a ratio of 117·03 females to every 100 males. In Edinburgh, in a total of 27,554 persons at the working age of 20, the excess of women was 2872; at the age of 25 the excess was 3065. As to the sexes at old age, at the age of 70, the numbers in Edinburgh were, men 1170, women 2174; at the age of 80, men 278, women 640; at the age of 90, men 21, women 53. In Aberdeen, at the age of 70, there were 692 men, 1264 women; at the age of 80, 180 men, 415 women; at the age of 90, 7 men, 32 women. These figures are not without interest in relation to the anatomical statistic above given.

is considered. Thus in the account of 41 "Specimens of Complete Dislocation of the Humerus preserved in the Anatomical Museums of London," given by Sir W. H. Flower (*loc. cit., infra*), in 36 of which the side is noted, 25 were of the right side, 11 of the left.[1]

(B.) Conclusions.

1. Fracture of the acromion process is, in all probability, a much more frequent occurrence than is usually supposed. It is liable to be overlooked from the absence, generally, of displacement, but may be detected on careful manipulation by the movement of the fragment and by crepitus. This conclusion appears to be fully established by the researches of Mr Arbuthnot Lane.

2. The facture may occur at any part; in front of the clavicular facet; opposite the facet; or behind the facet. Just behind the facet appears to be the usual locality.

3. This post-clavicular line is what may be termed the weak point of the acromion. This for two reasons: (*a*) The acromion is thick behind, supported and strengthened by the sub-acromial beam of the spine, and becomes thinner just behind the clavicular facet: (*b*) And, more especially, as the acromion in front of this is bound to and supported by the clavicle. Forces therefore tend to tell most on this part of the acromion.

4. The alleged relation between *rheumatoid arthritis* of the shoulder joint and separate acromion, as dwelt on by Adams and R. W. Smith, appears to be founded on misapprehension. The cases in which the co-existence has been recorded are not numerous, only 7 in number among the numerous cases of that disease in its advanced condition in which the parts were dissected. While there need be no difficulty in accepting the opinion that among the upward ravages seen in chronic rheumatic disease of the shoulder joint detachment of an ununited epiphysis, or detachment of an ossified acromion, may be one of the disintegrations, there is reason to believe that the rheumatoid condition is usually the result of former injury to the shoulder by which fracture of the acromion had been caused.

5. In regard to the non-union or separation of the *epiphysis* theory, the following are the considerations for and against it:— The place of junction of the epiphysis corresponds to the post-clavicular line. But although the epiphyseal line thus corresponds to the weak point of the acromion it is not the cause of the weakness, as after the union is completed (between the 22nd and 25th

[1] Although in the above-noted 24 cases of separate acromion only 3 are recorded as having the condition on both sides, it is not to be absolutely concluded that it may not have been present on the other side also in some of the other cases. Although it may, perhaps, be inferred generally that the condition was present only on the side preserved for the museums, those who are familiar with dissecting-room work will not infer that the other side was always examined or notes made, but we must go by what is known.

year) there is no difference in the internal structure and no special thinness exactly at the line of union. The correspondence of the two lines is incidental except in so far that the extent of the epiphysis appears to be in adaptation to the clavicular connexion. But the fact of the correspondence of the two lines introduces the element of doubt in the interpretation as between fracture and epiphyseal separation, when the separation occurs, as it usually does, at the post-clavicular line.

In support of the epiphysis theory may be given: (*a.*) That the usual place of separation corresponds to the place of epiphyseal meeting, expressed generally. Looking to the figures 2 to 5 of the development of the acromion given in the Plate (p. 9) we appear to have a satisfactory explanation of the locality being the usual one. (*b.*) It is conceivable that union may be delayed beyond the 25th year, and that if union does not occur at the usual period non-union may be permanent, as seen occasionally in the case of the inter-frontal suture. (*c.*) If the specimen has been from a subject under the 25th year the intervening layer of cartilage may have been broken by an accident to the shoulder, and the syn-arthrodial connexion thus converted into a diarthrodial joint by the movement of the parts, as after fracture of the ossified acromion followed by non-union. That, of course, brings the case into the category of fracture (diastasis), but the line is determined by the epiphysis.

Against the theories of non-union or detachment of the epiphysis, as occurring in the living body, may be put: (*a.*) There is a source of fallacy in regard to the interpretation of some specimens met with, in that they are but normal scapulæ just under the age at which the acromial epiphysis (the last of the epiphyses of the scapula to unite) is consolidated; the separation having taken place during maceration. Such scapulæ, wanting the epi-acromion but otherwise full-grown, are to be seen in museums. But in regard to specimens undoubtedly beyond that age—(*b.*) The line of post-clavicular separation is not exactly what would be expected had the cause been non-union or detachment of the epiphysis. Among the 13 specimens described in Part III., the separation begins, on the inner side, in some exactly at or very close to the posterior end of the facet (figs. 6 and 6a, case 3, and in cases 4, 5, 8, 9, and 11); in some a little in front of that point (fig. 8, case 7, $\frac{1}{8}$ inch in front; case 12, $\frac{3}{12}$ inch in front); in some a little behind (fig. 7, case 6, $\frac{1}{6}$ inch behind; case 1, $\frac{1}{6}$ inch behind; cases 10 and 13, $\frac{1}{12}$ inch behind).

These moderate variations in the starting-point of the separation on the inner side do not, perhaps, go against the epiphysis theory, as we do not know that normally the posterior limits of the epiphysis and of the facet correspond precisely to each other, but the outward course of the line of separation is not much, in some the opposite, of what we should expect when we bear in mind that

epiphyses have a very definite shape. As seen in figs. 2 to 5, the epiphysis meets the basi-acromion in a line curving outwards and very much backwards from the posterior end of the clavicular facet. Even should the posterior nucleus (*fig. 4) not unite with the main body of the epiphysis, the line of union is still curved with the concavity backwards. But in some of my specimens, as described, there is very little backward direction of the outer part of the line; in some the outward direction is even a little forwards. Figs. 6 and 6a show the direction to be different on the two sides in the same person, though symmetrical in regard to beginning on the inside just behind the facet. On the whole, the general direction of the line of separation, while somewhat undulating, may be regarded as transverse or nearly so.

Allowance must, no doubt, be made for any changes of form during perhaps many years of active working at a false joint after a supposed epiphyseal detachment; but, on the whole, when the line of separation usually seen is considered, the epiphyseal theory, whether by delayed union or by detachment, fails to satisfy, while the line of separation, as usually seen, with its minor variations at the post-clavicular region and its general transverse direction, tends to support the fracture theory.

6. The occasional occurrence of *symmetrical* separate acromion appears at first to be a difficulty in accepting the view that in all cases the condition is one of fracture, while it is intelligible on the theory of delayed union of the epiphysis, or as a result of advanced rheumatoid disease of both shoulder joints. Of the three cases above referred to, in two (those by R. W. Smith and J. G. Smith) there was rheumatoid disease, while in my case (No. 3, a female æt. 82, figs. 6 and 6a) there was no disease. These two theories, however, when critically examined as above, must be regarded as improbable, as inapplicable to at least the great majority of the specimens. It remains only to inquire whether the seemingly not very likely occurrence of fracture of both acromions can be believed as, after all, not so very unlikely to occur. This difficulty will disappear when we think of the occasional occurrence of dislocation of both shoulder joints, a result implying a much more forcible cause than would suffice to fracture the acromion. Of this occurrence I subjoin a reference to five cases.[1]

[1] 1. Adult male, the case in the Sir Charles Bell collection in the Edinburgh College of Surgeons' Museum, above noticed. Old-standing unreduced subglenoid dislocation of the humerus of both sides. Rheumatoid changes in both shoulder joints. Acromion fractured on left side with bony union.

2. In the same museum (New Cat., p. 193, Nos. 5, 6). Plaster cast of the front of the chest and shoulders of an adult. The dislocation on the right side was recent, that on the left side was old standing. Presented by the late Dr J. D. Gillespie, surgeon to the Royal Infirmary of Edinburgh. The dislocation is very manifest in both shoulders.

3. Case recorded by Mr C. E. Oldacres, of Daventry (*British Medical*

With such examples of symmetrical injury, in two of them both sides dislocated simultaneously, we need have little difficulty in believing in the occurrence of symmetrical fracture of the acromion process; the less so when we think of the number of tumbles the old frequenters of the drink-shops of London, Dublin, and Edinburgh must have had, first on one shoulder then on the other, before arriving finally at the dissecting-room.

The epiphysis theory is attractive to the anatomical mind, and it is not easy to part with the impression of one's earlier years in the dissecting-room, but when the evidence is critically examined has to be abandoned for the fracture theory. The explanation above given of the frequency of the locality in which the fracture is found to have occurred, the post-clavicular line, giving the family likeness to the great majority of the specimens, is, however, no less an anatomical one, and appears to me to be the true interpretation.

Appendix.

(*a.*) *Condition of the parts in Case No.* 1, *considered in relation to the occurrence of indentation or fracture at the anatomical neck of the humerus, accompanying sub-coracoid dislocation.*

Besides presenting characters of advanced rheumatoid arthritis following on the old injury, the chief interest of this specimen is in the femur-like elongation of the neck of the humerus, with a deep and wide post-cervical excavation. This character seems to render the specimen worthy of exact examination in relation to the apparently not infrequent occurrence of injury to the humerus as a complication in sub-coracoid dislocation. The condition in this specimen resembles that in the specimen noticed by me in 1862 (*Edinburgh Medical Journal*, vol. viii., 1862, p. 274) from a male subject æt. 76, now in the museum of the Edinburgh College of Surgeons (New Cat., vol i., p. 192, No. 5, 5) to which reference will be made below in comparison.

Condition of the parts. Subscapularis muscle present and of good size for a rather undersized scapula. *Ligaments:* Good capsular ligament all round. *Scapular attachments:* above, to inner half of anterior border of coracoid, for 1 inch, the coracoid broadened anteriorly at this part; from this, attachment

---

Journal, Nov. 9, 1895, p. 1162). A very muscular man; fell from roof of cottage; sub-glenoid dislocation of both shoulder joints, and fracture of left thigh-bone. Dislocations reduced.

4. Dr R. M'Dongall, of Gladstone, South Australia, relates (*same Journal*, 8th February 1896, p. 383) that the late Professor Sir George Macleod showed his pupils, at the Glasgow Royal Infirmary, in 1871, a case of dislocation into the axilla in both shoulders, and their reduction, in a woman æt. 45 or 50.

5. By Professor T. P. Anderson, of Sydney (*same Journal*, June 6, 1896), p. 1385). In the dissecting-room; old-standing dislocation of both shoulder joints. The man had been able to go about his work, as a drayman, until he was accidentally killed when intoxicated.

continued internally and below along inner and lower edge of new glenoid cavity. Externally and below, attachment normal along posterior and lower border of old glenoid cavity. *Attachments to humerus:* outer part to outer edge of great tuberosity; anterior and posterior parts to anterior and posterior borders of elongated neck; inner part, normally along original anatomical neck. Outer part of capsule thicker than normal, inner part not thickened. Thus, the capsule embraces both glenoid cavities above, and, below, not only the head but the elongated neck, out to the outer border of the great tuberosity.

Interior of the joint: Shows old-standing sub-coracoid dislocation, new sub-coracoid glenoid cavity, great elongation of neck of humerus, with deep and broad excavation behind, and changes from rheumatoid disease on both surfaces of joint, but these not extending upwards above old glenoid cavity. *Old glenoid cavity:* dimensions normal, height 1½ inches, breadth 1 inch; spongy at middle for half its breadth, upon which soft part of inner wall of great tuberosity of humerus has rested; eburnated behind, before and below the soft spongy part. Inner edge projects more at upper than lower half (the reverse of the normal); eburnated area towards this most projecting part corresponds to eburnated area on inner wall of great tuberosity, the projecting edge itself sinking to the bottom of the post-cervical excavation on humerus. Less projecting lower half of glenoid edge is rather rounded off towards new glenoid cavity, but is not much worn down.

New glenoid cavity: On subscapular fossa immediately to inner side of old cavity and continuous with it round the projecting eburnated inter-glenoid ridge. Dimensions greater than of old cavity, vertically 2 inches, transversely 1⅜ at lower half, less than that at upper half. It reaches up on base of coracoid process for ⅜ inch, occupying entire breadth of coracoid, which is here flattened and excavated vertically to form part of cavity. This coracoid part of new cavity reaches higher up than old cavity by about ¼ inch. Inner boundary of new cavity below this is marked by a sharp prominent ridge, running downwards and outwards on subscapular fossa. Concavity of new cavity much more marked vertically than transversely, owing to vertical curve of coracoid part. Surface of new cavity, spongy, with fibrous tufts, along inner half, eburnated along outer half. Against the eburnated part has played the back part of head of humerus, the part of the rheumatoid ring marked off from the smooth central part of the head. The projecting eburnated inter-glenoid ridge forms a bluntly acute angle, is above middle of old cavity, and opposite about middle of new cavity.

Humerus.—On articular surface of *head* two areæ to be distinguished,—a central ovoid area, size of pulp of thumb, smooth but thin articular cartilage which can be sliced with the knife; around this central area is a ring of irregularly nodulated smooth eburnated surface. The central area plays against inner (now anterior) side of capsular ligament, behind subscapularis muscle, bulging these forwards. The only part of the eburnated ring that has not rested merely on capsular ligament is the back and upper part, where it is increased in breadth, to about an inch, outwards to the excavation on the neck; this is the part that has played in the upper and inner part of the new glenoid cavity. This gives back of head a flattened shape (with a little transverse convexity) for an inch in length outwards. The normal anatomical neck should intersect the middle of this flattened part, but the form has been altered by the elongation at the back of the head throwing the anatomical neck outwards to where the excavation begins, in adaptation to the new glenoid cavity.

The *post-cervical excavation*, 1⅛ inch wide at the opening, about ⅔ inch deep, receives a good-sized finger. Outer wall eburnated on its upper part, where it played against the eburnated part on upper half of old glenoid cavity. Bottom of excavation over ¾ inch in length, has received the prominent wedge-like inter-glenoid ridge, and is smooth and polished behind, corresponding to lower part of the ridge. Inner wall of excavation, which has

rested in lower and outer part of new glenoid cavity, is less smoothly eburnated.

Divergence of great tuberosity. The great tuberosity is abnormally inclined outwards from line of shaft, here to extent of $\frac{3}{4}$ inch, the inclination beginning abruptly at $1\frac{1}{4}$ inch from summit of tuberosity. (Normal inclination in robust humeri only $\frac{1}{4}$ inch, or less, and much more gradual.) *Appearances of former fracture.* Below great tuberosity, on outer surface of shaft, there is appearance as if a scale or splinter of bone, $1\frac{1}{2}$ inch in length, $\frac{5}{8}$ in breadth, lower end $2\frac{3}{4}$ inches from summit of tuberosity, had been broken off and united. Scale is continuous with the tuberosity, as if both had been broken off together; the grooves bounding it are continued behind from just behind posterior border of tuberosity, in front from neck of humerus some way in front of tuberosity. The grooves are sharp and very evident, less so towards tuberosity. That there had been fracture is confirmed on making a longitudinal *section* of the head, neck and upper $\frac{1}{3}$ of the shaft. The appearances then seen are:—Medullary canal of shaft reaches into outer half of neck. Cancellous tissue of head easily broken down. Line of articular lamina of head distinctly seen to extend underneath the eburnated raised ring above noticed, which rises upon the lamina for $\frac{1}{4}$ inch. Line of former fracture well seen as a narrow lamina of dense bone intersecting the cancellous tissue internal and external to it; begins above at outer part of neck, $\frac{3}{4}$ inch to 1 inch from head, extends down for $2\frac{1}{4}$ inches, as indicated on outer surface of shaft, where it unites with dense wall of medullary canal. This clearly establishes that there had been fracture accompanying the sub-coracoid dislocation, the fracture splitting off the greater tuberosity and a long splinter of the shaft. The anatomical neck, internal to the fracture, had then in the course of time become elongated in adaptation to the movements on the inter-glenoid ridge and the new glenoid cavity.

[In the 1862 specimen, above referred to, the abnormal divergence of the tuberosity is less, but is very marked, begins about $1\frac{1}{4}$ inch from the summit of the tuberosity, and at that locality there is a jagged line towards the outside and behind as if this portion had been broken off with the tuberosity and united; but this indication is not nearly so distinct as in the new specimen. The post-cervical excavation is even wider and deeper. The description above given of the altered form of the head and of the two glenoid cavities might serve for both specimens, except that in the 1862 specimen the new glenoid cavity does not reach up on the coracoid, its upper end being $\frac{1}{2}$ inch lower than the upper end of the old glenoid cavity. The neck of the humerus, though greatly elongated, femur-like, is not so oblique as in the new specimen, so that top of the great tuberosity is not much below level of top of head. The long tendon of the biceps was normal.]

The parts show further results of chronic *rheumatoid arthritis:* various separate ossifications projecting into the joint from the capsular ligament or in the ligament. (*a.*) At inner and lower part of cavity, two, one size of small almond, one size of pea, hanging into the joint from the capsule near inner edge of new glenoid cavity. (*b.*) From upper part of capsule, two, size of pea. (*c.*) At bottom of post-cervical excavation, attached by fibrous tissue, one, larger than pea. (*d.*) At front of excavation, in the capsular ligament, two, a large one, 1 inch by $\frac{1}{4}$ inch, and one larger than pea. Many tufts and fibrous laminæ hang into the joint at where the capsular ligament is attached. The rheumatoid changes have not extended upwards towards the acromion, not above the old glenoid cavity. The attachment of the *biceps tendon* has been transferred to the humerus, firmly attached below the normally placed lesser tuberosity. The tendon is now about half the normal bulk and not tubular. (See my note on this condition of the transplanted tendon in the *Edinburgh Medical Journal*, vol. i., 1856, p. 953.) A vestige of the upper part of the tendon is seen partly incorporated with the capsule.

Movements and adaptations. The movements of the shoulder joint permitted by the ligaments are, flexion and extension pretty free, abduction and

adduction very moderate; not rotation, being prevented by the ligaments and by the elongated form of the neck. When the parts at the joint are placed in their acquired adaptation and the scapula held naturally, the shaft of the humerus is directed very much outwards. When the humerus is placed naturally, with only a little outward direction, the base of the scapula slopes very much outwards and upwards. It would seem that this oblique position of the scapula must have been acquired as an adaptation to the movements of the shoulder joint after the dislocation. The new adaptations at the shoulder joint may be stated generally as, that the back of the head rests in the new glenoid cavity, retained there by the subscapularis muscle and the untorn capsule; that the great tuberosity rests by its inner wall in the old glenoid cavity; and that the projecting inter-glenoid ridge sinks into the post-cervical excavation and forms a kind of pivot on which the two prominences move in their respective sockets.

Altered form and proportions of the upper end of the humerus. The increase in the length of the neck is seen by the following measurements:—Total length from outer wall of great tuberosity to middle of end of head, 2⅝ inches. (The same measurement in a normal muscular humerus, 2 inches.) The 2⅝ inches are apportioned thus: head with broadening externally, carrying the lesser tuberosity, 1⅛ inch; post-cervical excavation, at bottom, ⅞ inch; great tuberosity at same level, ⅝ inch. The neck is very oblique as well as elongated, so that the great tuberosity is considerably below the level of the head, to the extent of 1¼ inch in the natural adaptation, with the shaft of the humerus inclined outwards; to the extent of 1½ inch when the humerus is held vertically. (In the normal humerus, about ¼ inch.)

The fracture which appears to have accompanied the dislocation has been at the outer side of the part of the anatomical neck opposite the great tuberosity, and thence carried down so as to detach the great tuberosity with a splinter of the shaft below it.

(*b.*) It is a question of interest whether the post-cervical excavation, or groove, often seen in specimens of old unreduced subcoracoid dislocation, is brought about in the course of time by the pressure of the inter-glenoid ridge in adaptation to the new position of the parts, or has had its beginning in an indentation or fracture caused by the impinging of the prominent inner glenoid margin against the humerus at the time of the dislocation. Various writings bearing on this question may be referred to.[1]

Dr Joseph Bell points out the exact relation of the humerus to the scapula in the sub-coracoid and sub-glenoid dislocations, in the usual cases of moderate dislocation in which only the front of the capsule is torn, and the capsular

---

[1] *Sir William H. Flower*—"On the Pathological Changes produced in the Shoulder Joint by Traumatic Dislocation, as derived from an Examination of all the Specimens illustrating this Injury in the Museums of London," *Trans. Path. Soc. London*, 1861. *Dr Joseph Bell*—"On the Nomenclature of Scapulo-Humeral Dislocations," *Edin. Med. Journal*, May 1863. *Mr Frederick S. Eve*—"A Case of Sub-coracoid Dislocation of the Humerus, with the formation of an Indentation on the posterior surface of the Head, the joint being unopened; with Remarks on the Mode of Production of Fracture of the Anatomical Neck, with Dislocation," *Med. Chir. Trans. London*, March 1880. *Professor E. H. Bennett*, of Dublin, *Brit. Med. Journal*, August 1880, p. 349—"On Fracture of the Neck of the Humerus, as a complication of Dislocation of the Shoulder." *Mr Francis M. Caird*—"The Shoulder Joint in relation to certain Dislocations and Fractures," *Edin. Med. Journal*, Nov. 1886.

muscles not torn but stretched so as to retain the humerus in its dislocated position. That, in the sub-coracoid form, the projecting anterior glenoid border is received into the part of the anatomical neck behind the greater tuberosity, which he terms "the posterior groove of the humerus"; and that, in the sub-glenoid form, the projecting posterior ridge of the axillary border, in like manner, projects into and may be retained in the groove of the humerus. He further explains that this catching of the glenoid margin in the posterior groove of the humerus may go the length of producing "consecutive fissure of the head of the humerus," separating the greater tuberosity, caused "by the sharp edge of the glenoid border being forced as a wedge against the posterior groove of the humerus."

In the case related by *Mr Eve*,—that of a man, æt. 36, knocked down by a train while working on the line, the head of the bone distinctly felt beneath the coracoid process and the dislocation easily reduced, death twelve hours after the accident,—"on the posterior surface of the head of the humerus, at the margin of the articular cartilage, there was a deep vertical indentation or groove, into which the anterior margin of the glenoid cavity accurately fitted;" and he remarks—"I conclude that the groove was produced by the forcible impact of the humerus against the anterior margin of the glenoid cavity."

In this interesting paper Mr Eve says—"There are two dried specimens of shoulder joints in the museum at St Bartholomew's Hospital, showing dislocation of the humerus forwards with the formation of a groove or trochlear surface on the posterior portion of the head, evidently produced by attrition against the anterior margin of the glenoid cavity, which has itself been considerably worn away. Malgaigne (*Fractures et Luxations*, p. 496) has noticed the occasional occurrence of grooves on the head of the humerus after dislocation. He mentions two cases described by Sédillot, which presented much the same appearances as the above. In these specimens, as in the two former, the furrows were hollowed out by the movements of the head upon the glenoid margin, but Malgaigne remarks (p. 497) that he thinks it is a question if they are not sometimes produced, 'at the moment of dislocation, by the crushing of the head of the humerus upon the border of the glenoid cavity,' a conjecture which is proved correct by the case related. It is also probable that the commencement of the groove might, in some of the specimens mentioned, have been formed in a similar manner."

Mr Eve goes on to suggest that the occurrence of such a groove "may explain the mode of production of fracture of the anatomical neck with dislocation of the head of the humerus forwards. If the blow had been sufficiently forcible the head of the humerus would probably have been chipped off by the anterior margin of the glenoid cavity, instead of simply an indentation being produced by it." The specimen is in St Bartholomew's Hospital Museum; Cat., vol. i., p. 146, No. 1019.

Prof. Bennett "exhibited five examples of dislocation of the shoulder, complicated by fracture of the upper extremity of the humerus. In one of these, the dislocation was recent and the fracture incomplete; in the remaining, the fractures were completely united." Having reviewed the opinions of Delpech, Cooper, Malgaigne, Smith, and, lastly, of Mr Eve, on the mechanism of the double lesion, the author advanced his views, founded on the examination of the series of recorded cases and on the specimens exhibited, and expressed them in the following conclusions:—"1. Fracture of the upper extremity of the humerus occurring as a complication of the dislocation commences at that part of the anatomical neck which rests, after dislocation has taken place, against the border of the glenoid cavity. 2. It is caused by pressure of the humerus against the sharp edge of the glenoid cavity, probably the result of a constrained position, preventing the separation of the elbow from the side as in ordinary dislocations. 3. While the fracture starts at the anatomical neck, and may follow it strictly, it commonly passes into the shaft detaching the lesser tuberosity with the head. 4. The fracture is neither comminuted nor impacted." In the *Dublin Medical Journal* of March 1884, p. 359, Prof.

Bennett notices a specimen of Fracture of upper extremity of Humerus, history unknown, which had in his opinion been consecutive to dislocation; agreeing with his former specimens and confirming his opinion. The head united by ligaments to both scapula and humerus.

Mr Caird describes and figures two specimens of sub-coracoid dislocation in the museum of Edinburgh University. In one of these, a recent dislocation, there is an indented fracture, beginning at the upper and back part of the anatomical neck, forming a groove ¼ inch deep, ½ inch broad, and 1½ inches long, into which "the anterior lip of the glenoid cavity accurately fits." In the other, a dried specimen, the indentation is in the *head* of the humerus, 1 inch long, ½ inch deep, and the indentation "evidently corresponds to the anterior edge of the glenoid."

Mr Caird finds that "We can produce, although with some difficulty, and in a very artificial manner, a similar injury on the cadaver. Make a sub-coracoid dislocation, lay the subject prone, and strike the scapula violently. It will be found that a series of lesions may be obtained, varying in degree from a mere bruise of the glenoid cartilage onwards to indentation of the head of the humerus or to complete intracapsular fracture, the anterior lip of the glenoid, hard and dense, cutting into the cancellated tissue of the humerus like a knife." Reviewing the cases and opinions of the authors above quoted, he expresses the opinion—"It would appear, therefore, that we are justified in recognising the true type of sub-coracoid dislocation as being *always* associated with an indentation fracture of the head of the humerus caused by the dense, hard, anterior lip of the glenoid."

Sir William Flower's paper (*loc. cit.*) is of great value from the large number of facts he records and from the conclusions founded upon them. He fully recognises, writing in 1861, the misinterpretation of Adams in considering the rheumatoid condition to precede instead of being consequent on the dislocation. He brings out the striking fact that, of the 41 specimens of traumatic dislocation noted by him in the London museums, the position is *sub-coracoid* in 32—"placed upon the anterior margin of the glenoid fossa, or neck of the scapula, *immediately beneath* the coracoid process." The dislocation was backwards in four. In one (No. 11) the position had been described as "sub-clavicular," but the dislocation was recent and the head of the humerus had been removed from that position in putting up the preparation. In several other specimens described in the catalogues as of that kind, "the new socket is distinctly seen in the preparation to be immediately below the coracoid process. So that there is no specimen really illustrating the "sub-clavicular" variety, as defined by Sir A. Cooper ('the head of the os humeri placed below the middle of the clavicle, and on the sternal side of the coracoid process'), which is said by some authors to be second in order of frequency." In two of the specimens (Nos. 6 and 38) the position was "sub-glenoid"; as compared with the sub-coracoid, "somewhat lower down, the new socket being formed partly at the expense of the lower and anterior portion of the glenoid fossa, and partly on the anterior edge of the inferior costa of the scapula, the upper part of the head of the humerus being at a distance of somewhat less than an inch below the coracoid process. In one specimen (No. 23), the position is intermediate between this and the first mentioned (sub-coracoid) form. In no case is the head of the humerus placed entirely below the glenoid cavity."

As bearing on the great *preponderance of the sub-coracoid position* in museum specimens, Mr Caird (*loc. cit.*) remarks—"From the fact that our museums contain many examples of dislocation forwards, we are apt to imagine that the downward displacement is much rarer. One must remember, however, that this may mean no more than a relative difficulty in reduction. Of nine *recent* cases admitted lately to the Royal Infirmary, only one was sub-coracoid, eight were clearly sub-glenoid." On the other hand, Sir William Flower says, in regard to the sub-coracoid preponderance and in regard to the theory that the head of the humerus in neglected sub-glenoid dislocations passes up

to the sub-coracoid position—"As the great frequency of sub-coracoid dislocation observed in this series does not accord with the descriptions of this injury generally given in the standard surgical works of this country, and might lead to the supposition, that in these examples of neglected dislocation, the head of the humerus had in the process of time assumed a position which did not at first belong to it, I should mention, that in upwards of fifty cases recently observed in living patients, in a very large majority it could be distinctly felt immediately below the coracoid process, and that this has already been recognised as the typical position by most surgeons of the modern French school." These two statistical statements are not reconcilable. A more extended statistic is required. If Mr Caird is right, we are led to the conclusion either that sub-coracoid dislocations are frequently overlooked, which is not very probable, or that they are often accompanied by fracture of the humerus, rendering reduction difficult or impossible.

In regard to the occurrence of a *post-cervical groove* on the humerus, and its condition, in the 32 specimens of sub-coracoid dislocation tabulated by Sir W. Flower, the following appears:—Described as "grooved," 7; as "slightly grooved," 4; as "deeply grooved," 5; the groove generally at or near the outer side between head and great tuberosity. In two of "recent" dislocation, head of humerus "unchanged," but in one of them part of great tuberosity torn off. In two "rather recent," one "apparently unchanged"; the other "slightly grooved between head and great tuberosity." Two showed fracture at the anatomical neck, one of them with fibrous union, the other with false joint. One "apparently unchanged." The others variously altered in shape, but not described as grooved. Thus, in about half of the specimens of sub-coracoid dislocation noted by Sir W. Flower, the humerus showed the groove in various degrees. As the size of the groove is not given, it does not appear whether it amounted to the wide and deep excavation seen in my two specimens.

In regard to the *position of the new glenoid cavity* the distinction is made between the *sub-coracoid* proper and the *intra-coracoid* of Malgaigne (not "sub-clavicular"), in that in the latter the new cavity is quite internal to the old cavity, without grooving of the humerus; while in the former the new cavity encroaches on the old cavity, with grooving of the humerus. The distinction is but one of degree. According to that distinction the dislocation in my two specimens would be rather intra-coracoid, as the new cavity encroaches very little on the old one; but the position is strictly sub-coracoid in both. This may be co-related to the great width of the post-cervical excavation in them, with consequent elongation of the neck, enabling the head to play in the new cavity and the tuberosity to play against the old cavity.

In regard to the *causation of the post-cervical groove or excavation*, it is a question whether it is the result of gradual adaptation, the glenoid edge resting originally in the natural groove presented by the part of the anatomical neck at the great tuberosity and working a deeper groove in the course of time. Supposing that to be the position of parts at the dislocation, and so retained by the capsular muscles, there need be no difficulty in receiving that view of the formation of a deeper and broader groove in the humerus. More probably there is, to begin with, an indentation or partial fracture at or near the anatomical neck, caused by the impact of the glenoid edge. In at least one of my two specimens (case No. 1) there had evidently been a fracture, splitting off the greater tuberosity with a splinter of the shaft; bony union had taken place, and the great elongation of the neck must have been a gradual process in adaptation to the movement on the prominent inter-glenoid ridge.

(c.) *Note on the normal neck of the humerus.* The part loosely, though conveniently in surgery, called the "surgical neck," is not definable except generally as about the upper inch or so of the shaft, where it enlarges towards the head and tuberosities, as seen on all sides. In diastasis the line of fracture is quite at the upper part of the surgical neck, as the line of the epiphysis, transverse with minor undulations, cuts off exactly the articular head and the tuberosities. But

most of the so-called surgical neck belongs on the inner side to the anatomical neck, or neck proper of the humerus. The "anatomical neck" appears to be understood by some as if passing round on all sides just beyond the articular head. At the tuberosities it is a well-marked furrow, $\frac{1}{8}$ to $\frac{1}{4}$ inch in breadth, but below the inner half of the head the bone slants uniformly towards the shaft for about $\frac{3}{4}$ inch, without any definite limit below, or any above except the edge of the cartilage, or, in the macerated bone, the articular lamina. The length and obliquity of the neck may be observed equally in front and back views. Seen in front, the axis of the shaft runs up at the outer edge of the lesser tuberosity; the axis of the neck intersects the middle of the lesser tuberosity, and runs out below the greater tuberosity about $1\frac{1}{2}$ inches from its summit. Seen behind, the axis of the shaft runs up a little internal to the great tuberosity; the axis of the neck passes at the lower edge of the great tuberosity. A considerably obtuse angle is formed below where the axes of the shaft and neck meet. The direction of the neck is inwards, upwards, and backwards; the backward direction best seen on viewing the bone from the outer side.

In dissection, it is seen that most of the neck is within the capsule. At the tuberosities the capsular tendons, there representing the capsular ligament, are attached to the smooth facets of the tuberosities, encroaching a little inwards at the outer side of the anatomical neck, but the narrow anatomical neck is seen free and covered by synovial membrane. Below the head, the capsular ligament is attached from $\frac{1}{4}$ to $\frac{1}{2}$ inch from the articular edge, leaving that extent of periosteal bone within the capsule and covered by synovial membrane.

It may here be observed, in regard to possible impact against the glenoid edge, that, in manipulating with a normal unopened capsule, it does not appear possible to bring the posterior part of the anatomical neck against the anterior glenoid edge by any movement or position without rupture of the front of the capsule. By extreme rotation inwards the fore part of the anatomical neck may be brought in relation with the anterior glenoid edge; by extreme rotation outwards the back of the anatomical neck may be brought in relation with the no less projecting posterior glenoid edge. By gliding movement forwards or backwards, without or with rotation, the articular surface of the head may be brought against the anterior or the posterior glenoid edge and might be indented or fissured vertically; by downward gliding the articular surface may be brought against the lower end of the glenoid margin, and thus produce a transverse fissure. All without any tearing of the capsular ligament.

In regard to the sub-glenoid position the following may be noted. The sub-glenoid or axillary groove, extending along about the upper half of the axillary border, is at the upper part $\frac{1}{2}$ inch in breadth and faces obliquely forwards. Here, its outer border, the upper part of the true axillary border, is prominent and rough, where it attaches the long head of the triceps, and this ridge might catch in the back of the anatomical neck in a sub-glenoid dislocation. The beam forming the inner boundary of the groove, stronger below than the outer boundary, falls at about an inch from the glenoid cavity, and thus leaves a vertically concave area where the back of the head of the humerus may rest in a sub-glenoid dislocation.

The specimens described in this paper were shown and considered anatomically at the Anatomical Society of Great Britain and Ireland, in London, in Nov. 1887, and shown and considered surgically at the Edinburgh Medico-Chirurgical Society in June 1894.

PRINTED BY OLIVER AND BOYD, EDINBURGH.